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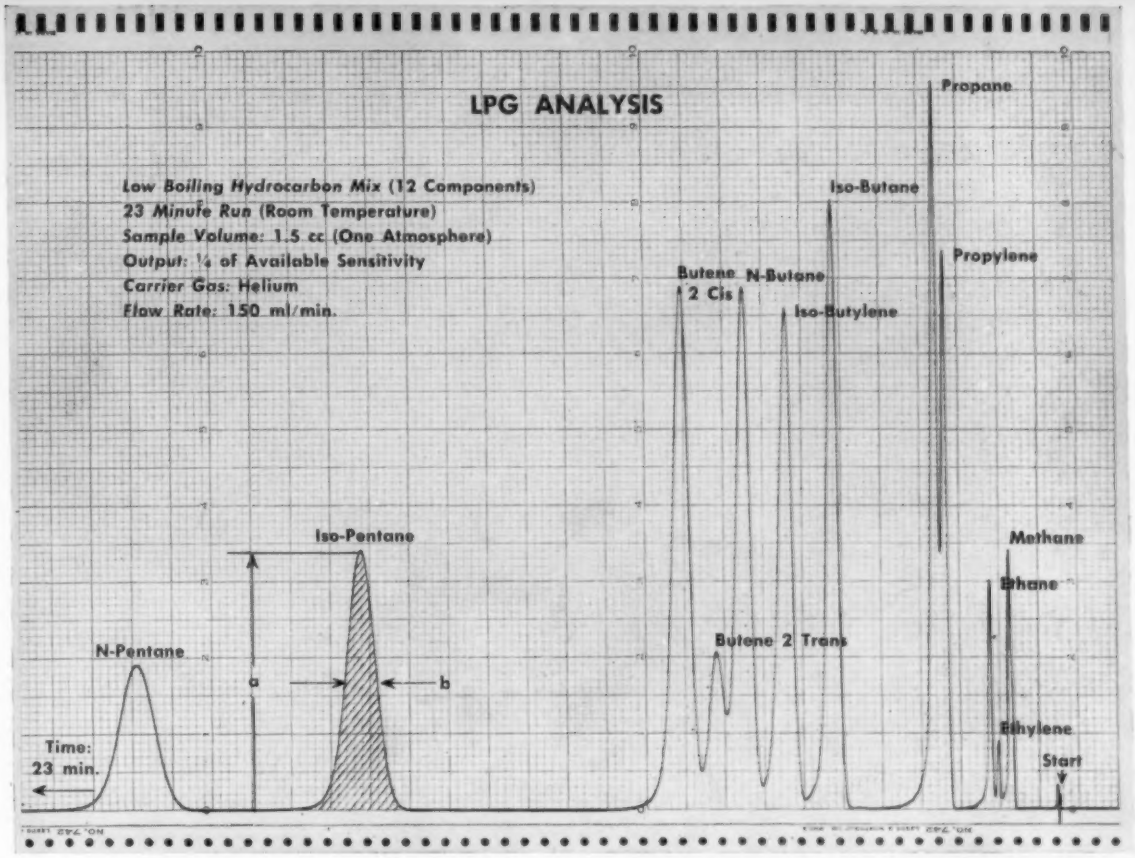

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Laboratory Equipment and Tariff Policy

The high-school or college science teacher who wishes to purchase new laboratory equipment faces a dilemma. If he tries to buy from an American manufacturer, he runs into the fact that scientific supply houses are turning an increasing portion of their facilities to supplying the larger industrial market. If he considers buying from abroad, he runs into the barrier of an import duty as high as 50 percent.

The United States imposes a higher import duty on scientific instruments and apparatus used for educational purposes than does any other Western country. New Zealand, the country with the next highest rate, charges 20 percent. Sweden charges 10 percent; the Netherlands, 3 percent; and in Canada and more than a dozen other countries, such equipment is admitted duty free.

The American Association of Physics Teachers has become concerned about the quality and availability of scientific apparatus, particularly for some of the newer experiments, and has appointed a committee headed by Sanborn C. Brown of Massachusetts Institute of Technology to see what can be done. One possibility is the reduction or elimination of the high import tariff. The AAPT committee has discussed this possibility, with encouraging results, with Senator Leverett Saltonstall. Senator Saltonstall has invited correspondence from educational groups concerned with the problem of securing satisfactory research and teaching equipment. The U.S. Commissioner of Customs has given the following opinion concerning the feasibility of eliminating the import tariff.

"In the Tariff Act of 1913 provision was made for the free entry of scientific apparatus when imported by certain societies and institutions for educational or scientific purposes. This provision of the law was omitted by Congress from the Tariff Act of 1922 and from the current law, Tariff Act of 1930. It is the opinion of the Bureau that no unusual administrative difficulties would be presented by legislation allowing the free entry of the merchandise in question for educational institutions."

A more recent precedent is found in the UNESCO-sponsored agreement to admit audio-visual aids for educational purposes without duty. The United States has signed but not yet ratified this agreement.

Dropping the tariff would not seriously affect the income of equipment manufacturers. As of 1953, only 11 percent of the nation's research and development expenditures was chargeable to educational institutions. The fraction that went for the purchase of equipment that might come either from domestic or foreign suppliers is unknown, but certainly it is small.

It appears that elimination or substantial reduction in current import duties would be a great boon to educational institutions and of small moment to American industry. If this expectation is wrong, there remains an escape clause in existing tariff law and regulations whereby any special concessions can be withdrawn if it can be shown that they cause or threaten serious injury to a domestic industry producing like or directly competitive products.

Since some excellent and inexpensive educational apparatus is again being produced abroad, the AAPT committee believes it desirable to facilitate importation and invites the support of other interested groups in bringing about the hoped-for change in tariff policy.—D.W.

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Stress and Disease

Hans Selye

Almost two decades have passed now since the publication of a short note on "A syndrome produced by diverse nocuous agents" (*1*). Since that time, the relationships between this "general-adaptation syndrome," or "stress syndrome," and virtually every branch of physiology and clinical medicine have been subjected to study. Those who seek detailed information concerning certain aspects of the stress problem will find a key to the world literature in the monographs (*2–10*) and yearbooks (*11–14*) that are especially devoted to this topic. Hence there is no need to burden this text with numerous references. It may be opportune, however, to take stock now in the form of a brief synopsis surveying the most fundamental facts that we have learned about the relationships between stress and disease. This will give us an opportunity also to outline what we would consider to be the principal scope and the limitations of this new approach to problems of medicine (*15*).

Ever since man first used the word *disease*, he has had some inkling of the stress concept. The very fact that this single term has been used to denote a great variety of manifestly distinct maladies clearly indicates that they have been recognized as having something in common. They possess, as we would now say, some "nonspecific disease features" (the feeling of being ill, loss of appetite and vigor, aches and pains, loss of weight, and so forth), that permit human beings to distinguish illness from the condition of health. Yet, precisely because these manifestations are not characteristic of any one disease, they have received little attention in comparison with the specific ones. They were thought to be of lesser interest to the physician, for, unlike the specific symptoms and signs, they did not help him to recognize the "eliciting pathogen" or to prescribe an appropriate specific cure. Whenever it was impossible to determine precisely what the cause of the trouble was, therapy had to be limited to such general measures as the recommendation of rest, an easily digestible and yet nutritious diet, protection against great variations in the surrounding temperature, or the use of salicylates to stop pain.

Experience had likewise shown long ago that what we now call nonspecific stress can also have certain remarkable curative properties under certain conditions. Nonspecific therapy was consciously or unconsciously based on this principle. In the Middle Ages, flogging of the insane was practiced "to drive the evil spirit out of them." This procedure was subsequently replaced by the more humane fever therapy, Metrazol shock, insulin shock, electroshock, and numerous other measures, but all of these have in common the property of producing a state of systemic, nonspecific stress. Such practices as bloodletting, fasting, or the parenteral administration of milk, blood, and colloidal metals may serve as additional examples of nonspecific procedures, which undoubtedly can produce beneficial results in patients afflicted by a variety of diseases. These measures were, and some of them still are, widely used for lack of more effective and less traumatic means of therapy. However, the mechanism of their action remained obscure, and therefore scientifically minded physicians were always reluctant to use them, for they recognized that these treatments were actually stabs in the dark whose consequences could never be accurately foretold.

Perhaps the most fundamental difference between medieval and modern medicine is that the former was primarily based on pure empiricism and directed by mysticism and intuition, whereas the latter attempts to understand the mechanisms of disease—through an objective scientific analysis—and to treat it by influencing well-defined points along the pathways of its development. Up to the present time, the greatest progress that has been made along these lines has resulted in specific therapeutic procedures that are designed to eliminate in each case the particular primary cause—the eliciting pathogen of a disease—for instance, by chemotherapeutic measures or with the surgeon's knife.

By contrast, throughout the centuries, we have learned virtually nothing about rational, scientifically well-founded procedures that would help the body in its own natural efforts to maintain health quite apart from the attacks on the pathogen. Yet, often, the causative agent cannot be recognized or is not amenable to any therapeutic procedures directed specifically against it. Besides, elimination of the causative agent frequently does not cure, because the effects of the disease producer may greatly outlast its actual presence in the body. Let us remember that it is not the microbe, the poison, or the allergen but our reactions to these agents that we experience as disease. A man may die from a single exposure to ionizing rays, a rheumatic heart, or an infectious nephritis long after the original cause of his illness is no longer present in his body.

Whenever the available procedures of specific therapy are imperfect, the physician is forced to say that he has done what he could and "nature will do the rest." The fact is that very often nature actually does the rest, but unfortunately not always. Indeed, we may say that the leitmotiv of our work on stress was the question: "How does nature do 'the rest' and, when nature fails in this, could we not help if we learned more about natural methods?"

When we were first confronted with the "alarm reaction," the idea that presented itself most vividly was that the very tangible and accurately measurable

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morphologic characteristics of this first stage of the stress response might give us a key to the objective scientific analysis of systemic, nonspecific reactions. The enlargement of the adrenal cortex and the atrophy of the thymus and lymph nodes, for example, were changes that could be expressed in strictly quantitative terms, and they were certainly not specific, since any agent that caused systemic damage or stress elicited them.

A multitude of questions presented themselves immediately. Which among the manifestations of this alarm reaction are useful for the maintenance of health and which are merely signs of damage? How does an injury to a limited area of the body reach the various internal organs that are eventually affected during the alarm reaction? For instance, how does a trauma to one limb eventually influence such distant structures as the adrenal cortex or the thymus? Which organ change is the cause and which the consequence of another structural alteration? For instance, does the disintegrating thymus tissue liberate substances that stimulate the adrenals or does the enlarged adrenal cortex secrete hormones that affect the thymus?

It was quite evident, of course, that to answer these questions would take much time and probably long series of often monotonous stereotypic experiments, using various stressors on various species of animals. Nevertheless, a general blueprint for the dissection and clinical utilization of the stress syndrome presented itself immediately. In particular, we asked ourselves five questions, which we thought would now be amenable to experimental analysis: (i) What are the changes characteristic of stress as such? (ii) How does the stress response evolve in time? (iii) What are the pathways through which stress reaches various organs? (iv) Are there "diseases of adaptation," that is, maladies principally the result of errors in the adaptation syndrome? (v) To what extent are the animal experiments on stress applicable to clinical medicine?

None of these questions has been fully answered, and, indeed, the complete clarification of biologic problems is hardly an attainable aim. However, partial answers have been obtained to all of these basic questions, and—most important of all—it appears that they have been so formulated that further progress is now largely a matter of time.

We have learned, for instance, that acute involution of the lymphatic organs, diminution of the blood eosinophiles, enlargement and increased secretory activity of the adrenal cortex, and a variety of changes in the chemical constitution of the blood and tissues are truly nonspecific and characteristic of stress as such. It has also become evident that they represent a syndrome, in that they are closely correlated with one another, both in time and in intensity. Whenever dissociations among them tend to occur, it can usually be shown that these are attributable to one of the following two reasons: (i) either the specific actions of the evocative agent are superimposed upon the stress syndrome and thus obscure some of the nonspecific manifestations (for example, if insulin is used as a stressor, the glycemic response is masked by the hypoglycemic effect of the hormone); or (ii) one of the pathways through which stress acts in the organism is deranged (for example, stress causes no thymus involution after adrenalectomy).

No agent produces only stress. Hence, in actual experimentation, the stress response is invariably complicated by certain superimposed specific changes, and in every species—indeed, in every individual—one or the other pathway is more or less functional than the rest. These factors tend to mask or deform the typical stress response, and failure to recognize them was undoubtedly the principal handicap to clear characterization of the stress response in the past. Let us now return to our five basic problems and enumerate at least the most important facts about them that have come to light during these 20 years of research on stress.

Changes Characteristic of Stress

In attempting to answer the question, "What are the changes characteristic of stress as such?" the first problem was, of course, to define *stress*, at least as accurately as definitions can be formulated in biology. The word, especially when it is used with its mate *strain*, has long been in everyday usage, but its significance in biology had never been defined. The layman speaks, for instance, of *eyestrain* or *mental stress* in referring to rather specific complaints. Cannon, the great student of homeostasis, also used the terms *stresses* and *strains* in connection with specific reactions. He emphasized, for instance, that the stresses and strains of oxygen lack, hemorrhage, and starvation elicit totally different and specific homeostatic reactions. Conversely, it is a characteristic of the stress syndrome, as we understand it, that it is always the same, no matter what happens to elicit it. For over-all responses, which include specific and nonspecific features—and this is even more true of purely specific responses—the term now used would be *reaction* (not *stress*) and the eliciting agent would be called a *stimulus* (not a *stressor* or *alarming stimulus*). Such specific reactions are precisely the part of the over-all response that we must subtract to arrive at our stress syndrome.

To make this distinction clear, we always used the term *nonspecific stress* in our early publications. Later, unfortunately, it became customary to omit the adjective, for brevity's sake. To avoid confusion, we then pointed out that in the sense in which we use the term, stress may be defined as a nonspecific deviation from the normal resting state; it is caused by function or damage and it stimulates repair.

Here, the nonspecific causation of the change has been selected as its most characteristic feature. However, even the term *specific* had been used somewhat loosely in medicine; we therefore defined a nonspecific change as one that can be produced by many or all agents, as opposed to a specific change, which is elicited only by one or few agents. Correspondingly, a nonspecific agent acts on many targets, a specific one acts on few targets, and a stressor is an agent that causes stress.

Of course, we realized from the outset that these, like all biologic definitions, are imperfect, but trying to formulate them helped us to impart precision to our own concepts of *stimulus, stressor, stress, specific,* and *nonspecific*. Among other things, these considerations brought out with particular clarity the fact that stress is not necessarily the result of damage but can be caused by physiologic function and that it is not merely the result of a nonspecific action but also comprises the defense against it. These are cardinal facts, as we shall see later when we consider the relationship between stress and disease.

In our efforts to identify the characteristics of stress, our main problem was to eliminate all specific manifestations that are typical either of the agent or of the reacting organism. Hence, a large number of animal species had to be studied, following exposure to a great variety of essentially different stimuli, to compare the resulting structural, chemical, and functional changes. This made it possible to determine which are the responses common to all types of exposure, and only these could be considered to be truly nonspecific—that is, the result of stress as such. The residue that remained after subtraction of all the specific changes is the general-adaptation syndrome.

In this response, every part of the body is involved, but the two great integrators of activity, the hormonal and the nervous systems, are especially important. The facts known today may lead us to believe that the anterior pituitary and the adrenal cortex play the cardinal roles in coordinating the defense of the organism during stress. This view is probably distorted by the fact that the syndrome has been

studied primarily by endocrinologists, and investigations concerning the participation of the nervous system are handicapped by the greater complexity of the required techniques. It is considerably easier to remove an endocrine gland and to substitute for its hormones by the injection of extracts than it is to destroy minute individual nervous centers selectively and then restore their function to determine the role they may play during stress.

Stress Response in Time

To establish the evolution of the stress response in time, animals had to be repeatedly exposed to stressors (cold, forced muscular exercise, bloodletting, and drugs) of a constant intensity over long periods of time. It was found that, after a while, the same agent does not continue to produce the same nonspecific response. For instance, treatment with a drug that initially causes discharge of adrenocortical lipid granules will later actually promote accumulation of lipids in the adrenal cortex, after the animals have become more resistant to the damaging effects of the agent. Upon still more continued exposure, sooner or later, this acquired adaptation is invariably lost; then the animals again show signs of damage, and their adrenal cortices again discharge their lipid granules.

These adrenal changes are taken as only one example among the many characteristics of the general-adaptation syndrome that show such a triphasic pattern (for example, glycemia, chloremia, and body weight). In fact the whole syndrome is essentially triphasic; thus its manifestations depend as much on the stressor effect of the eliciting agent as on the time elapsed since the organism was first exposed to it.

The three stages of the stress syndrome are (i) the alarm reaction, in which adaptation has not yet been acquired; (ii) the stage of resistance, in which adaptation is optimum; and (iii) the stage of exhaustion, in which the acquired adaptation is lost again.

The physicochemical basis of the curious terminal loss of acquired adaptation is still quite obscure. Exhaustion cannot be fully compensated, either by changes in the caloric intake or by any known hormonal substitution therapy. The term *adaptation energy* has been suggested to designate the adaptability that is gradually consumed during exposure, but despite much research we have learned nothing about the nature of this "energy."

Many of the changes characteristic of the stage of exhaustion are strikingly similar to those of senility. It is tempting to view the general-adaptation syndrome as a kind of accelerated aging. It appears as though, because of the greater intensity of stress, the three major periods of life —infancy (in which adaptation has not yet been acquired), adulthood (in which adaptation has been acquired to the usual stresses of life), and senility (in which the acquired adaptation is lost again)— are here telescoped into a short space of time.

However, these will remain sterile speculations until some ingenious mind can devise new experimental procedures with which to analyze them in quantitative terms. It is only to stimulate thought along these lines that I venture even to mention these problems here. I hope that some talented young mind, still sufficiently uninhibited by textbook knowledge to see a new approach, will follow this trail. To me it seems more promising of truly great progress in the understanding of life and adaptability than any other aspect of stress research.

Pathways of Stress

To clarify the pathways through which stress reaches various organs, it was merely necessary to use the classic procedures of experimental medicine— namely, the destruction of suspected relay stations and, wherever possible, their restoration (for example, removal of an endocrine gland and substitution therapy with extracts containing its hormones.) Figure 1 helps to summarize the principal data that have come to light in this respect.

All agents that act on the body or any of its parts exert dual effects: (i) specific actions, with which we are not concerned in this review, except insofar as they modify the nonspecific actions of the same agents and (ii) nonspecific or stressor effects, whose principal pathways (as far as we know them today) are illustrated in Fig. 1. The stressor acts on the target (the body or some part of it) directly (thick arrow) and indirectly by way of the pituitary and the adrenal. Through some unknown pathway (labeled by a question mark), the "first mediator" travels from the directly injured target area to the anterior pituitary. It notifies the latter that a condition of stress exists and thus induces it to discharge adrenocorticotrophic hormone (ACTH).

It is quite possible that this first mediator of hormonal defense is not always the same. In some instances, it may be an adrenaline discharge, in others a liberation of histaminelike toxic tissue metabolites, a nervous impulse, or even a sudden deficiency in some vitally important body constituent (such as glucose or an enzyme). During stress it is rarely the lack of adrenal corticoids that stimulates ACTH secretion, through a self-regulating "feed-back" mechanism.

ACTH, alone or in cooperation with other hormones, stimulates the adrenal cortex to discharge corticoids. Some of the cortical hormones, the mineralocorticoids, also known as prophlogistic corticoids (P-Cs), stimulate the proliferative ability and reactivity of connective tissue; they enhance the "inflammatory potential." Thus, they help to put up a strong barricade of connective tissue through which the body is protected against further invasion by the pathogenic stressor agent (examples are desoxycorticosterone and aldosterone).

However, under ordinary conditions, ACTH stimulates the adrenal much more effectively to secrete glucocorticoids, also known as antiphlogistic corticoids (A-Cs). These inhibit the ability of the body to put up granulomatous barricades in the path of the invader; in fact, they tend to cause involution of connective tissue with a pronounced depression of the inflammatory potential. Thus they can suppress inflammation, but, by this same token, they open the way to the spreading of infection (examples are cortisol and cortisone).

Certain recent experiments suggest that, depending on the conditions, ACTH may cause a predominant secretion of one or the other type of corticoid. However, be this as it may, the "growth hormone," or somatotrophic hormone (STH), of the pituitary increases the inflammatory potential of connective tissue very much as the prophlogistic corticoids do; hence, it can sensitize the target area to the actions of the prophlogistic corticoids.

It is possible that the hypophysis also

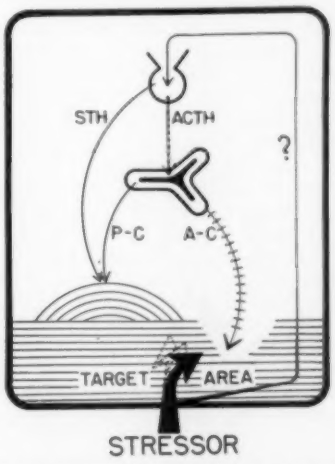

Fig. 1. Diagram illustrating the principal pathways of the stress response. [After Selye (*3*)]

secretes some special corticotrophin that induces the adrenal to elaborate predominantly prophlogistic corticoids; indeed, STH itself may possess such effects, but this has not yet been proved. Probably the electrolyte content of the blood can also regulate mineralocorticoid production. In any event, even if ACTH were the only corticotrophin, the actions of the corticoids produced under its influence can be vastly different, depending on "conditioning factors" (such as STH) that specifically sensitize the target area for one or the other type of corticoid action. Actually, conditioning factors could even alter the response to ACTH of the adrenal cortex itself, so that its cells would produce more antiphlogistic or prophlogistic corticoids. Thus, during stress, one or the other type of effect can predominate.

As work along these lines progressed, it became increasingly more evident that the actions of all the "adaptive hormones" (corticoids, ACTH, STH) are so largely dependent on conditioning factors that the latter must be considered to be equally as important, in determining the final outcome of a reaction to stress, as the hormones themselves. It will be rewarding, therefore, to discuss this topic thoroughly.

Conditioning of hormone actions. Heredity, age, previous exposure to stress, nervous stimuli, the nutritional state, and many other factors can affect both the production of the adaptive hormones and their effect on individual target organs. The action of mineralocorticoids on most of their target tissues is augmented, and that of glucocorticoids is diminished, by an excess of dietary sodium. However, stress during the secretion of adaptive hormones is perhaps the most effective and most common factor capable of conditioning their actions. Thus systemic stress augments the antiphlogistic, lympholytic, catabolic, and hyperglycemic actions of antiphlogistic corticoids. Furthermore, one of the salient effects of the adaptive hormones, that of modifying the course of inflammation, naturally cannot manifest itself unless some "topical stressor" (for example, a nonspecific irritant acting on a circumscribed tissue region) first elicits an inflammatory response.

A few words about the recently introduced concept of the "permissive actions" of corticoids may be in order here. This hypothesis assumes that the corticoids do not themselves affect the targets of stress but merely permit stressors to act on them. Thus the presence or absence of corticoids could only allow or disallow a stress reaction but could not vary its intensity. To illustrate this concept, one might compare the production of light by an electric lamp to the biologic reaction and the switch to the permissive factor. The switch cannot produce light or regulate the degree of its intensity, but unless it is turned on the lamp will not function. Correspondingly, the functional signs—generally considered to be characteristic of overproduction of corticoids during stress—would result not from any actual increase in corticoid secretion but from the extra-adrenal actions of the stressors themselves. The presence of corticoids would be necessary only in a "supporting capacity" to maintain the vitality and reactivity of tissues (*16*).

Actually, it is precisely in the specific and not in the nonspecific (stress) reactions that the corticoids play a purely permissive role of this type. Here they are necessary only to prevent stress and collapse, thus keeping the tissues responsive. For instance, adrenalectomized rats will not respond to injected STH with somatic growth or to sexual stimulation with mating without a minimal-maintenance corticoid treatment. However, these are specific reactions; they are not characteristic either of stress or of the corticoids and could not be duplicated in the absence of the specific stimulus (STH and sexual stimulation), even with the highest doses of corticoids.

The characteristics of antiphlogistic corticoid overproduction that we see in the alarm reaction (for example, atrophy of the lymphatic organs, catabolism, and inhibition of inflammation) are also impeded by adrenalectomy; they are also restored even by mere maintenance doses of antiphlogistic corticoids in the presence of stress, because the latter sensitizes, or conditions, the tissues to them. The fundamental difference is, however, that —unlike specific actions—these nonspecific effects can be duplicated, even in the absence of any stressor, if large doses of antiphlogistic corticoids are given.

The importance of such conditioning influences is particularly striking in the regulation of stress reactions, because, in the final analysis, they are the factors that can actually determine whether exposure to a stressor will be met by a physiologic adaptation syndrome or cause "diseases of adaptation." Furthermore, in the latter instance, these conditioning factors can even determine the selective breakdown of one or the other organ. We are led to believe that differences in predisposition, caused by such factors, might explain why the same kind of stressor can cause diverse types of diseases of adaptation in different individuals.

"Buffering action" of the adrenals. It has long been noted that it is much more difficult to obtain overdosage with either glucocorticoids or mineralocorticoids in the presence than in the absence of the adrenals. Thus, for instance, cortisol exerts its typical actions (for example, on inflammation, body weight, and the thymicolymphatic organs) at much lower dose levels in intact rats than it does in adrenalectomized rats. This is largely, if not entirely, the result of the absence of mineralocorticoids, for it proved possible to restore the glucocorticoid resistance of the adrenalectomized rat to normal by treatment with small doses of mineralocorticoids (desoxycorticosterone and aldosterone). Even a mere excess of dietary sodium can, at least partially, substitute for the adrenal in such experiments; hence it is reasonable to assume that here the mineralocorticoids antagonize the glucocorticoids, as a direct result of their effect upon mineral metabolism.

These experiments definitely disproved the so-called "unitarian theory" of adrenocortical function, which was still held by some of the most distinguished adrenal physiologists a short while ago. It is clear not only that the cortex produces more than one kind of corticoid but that the mineralocorticoids and the glucocorticoids are mutually antagonistic in many respects, as postulated by the "corticoid balance theory."

However, several observations still did not seem to be consonant with our concept of corticoid antagonism. For instance, in the presence of the adrenals, both in experimental animals and in man, it proved extremely difficult to stimulate inflammatory reactions much above normal, even with very large doses of mineralocorticoids. On the other hand, glucocorticoids always succeed in overcoming the buffering action of an intact adrenal, as long as the dosage is sufficiently high.

It is only quite recently that the cause of this apparent exception to the concept of adrenal hormone antagonism has been clarified by the demonstration that the corticoids act in accordance with the "law of intersecting dose-effect curves."

Law of intersecting dose-effect curves. When a solution containing fixed proportions of cortisol acetate and desoxycorticosterone acetate (DCA) is administered to adrenalectomized rats, the cortisol action (catabolism, thymolysis, and inhibition of inflammation) predominates at low, and the opposite, desoxycorticosterone type of activity, predominates at high dose levels. This was ascribed to the fact that the DCA activity rises rapidly to its optimum level, but then a "ceiling" is reached, and raising the dose further will not increase the effect. The cortisol type of activity, on the other hand, rises more slowly but does not flatten out until it far exceeds the ceiling of its antagonist (Fig. 2).

The relationship between the two types of corticoids explains why it is readily possible to overcome the adrenal buffer with appropriate doses of cortisol-like hormones, whereas even the highest doses

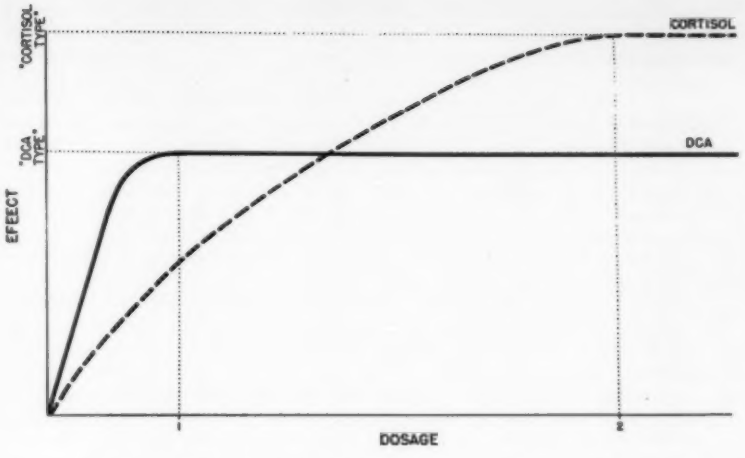

Fig. 2. Effect of varying the dose while the cortisol/desoxycorticosterone quotient is kept constant. Difference in the slopes results in intersecting dose-effect curves. [After Selye and Bois (*18*)]

of DCA cannot inhibit this effect. In the presence of the adrenals the normal level of mineralocorticoid production is usually already at its optimum of efficacy. This may also explain the frequently made observation that in adrenalectomized animals and man—where the starting point is below the mineralocorticoid ceiling—desoxycorticosterone stimulates inflammatory phenomena (for example, arthritis), and this can be antagonized by concurrent treatment with cortisol.

However, in certain respects, the desoxycorticosterone action does not appear to have a definite ceiling. Thus, in the rat, the production of renal damage by desoxycorticosterone is quite proportional to the amount given, within a very wide dose range.

Exceptional position of the kidney among the targets of corticoid activity. Numerous observations show that there exists a rather special relationship between the corticoids and the kidney, a relationship that clearly distinguishes renal tissue from other targets of corticoid activity.

Thus, the renal damage (nephrosclerosis) produced with high doses of desoxycorticosterone, in the rat, is not antagonized but is actually aggravated by concurrent treatment with cortisol. In other words, here there is no mineralocorticoid-glucocorticoid antagonism.

Furthermore, the kidney-damaging effect of various agents (for example, cold, foreign proteins, large doses of STH-preparations, and methylandrostenediol) can be prevented by adrenalectomy, while their extrarenal effects (including, for instance, the influence of STH and methylandrostenediol upon inflammation) are not markedly affected.

The cause of this exceptional reactivity of renal tissue to corticoids is not yet known. However, two factors undoubtedly play an important role here: (i) glucocorticoids and mineralocorticoids are not strictly antagonistic (and may even be synergistic) in their actions on the kidney; (ii) the inability of mineralocorticoids to produce more than a limited effect on extra-adrenal tissues (no matter how much the dose is raised) does not apply to the kidney.

In the preceding discussion we have just barely mentioned the "topical stressors," but now we shall have to consider these a little more carefully before we turn our attention to the diseases of adaptation.

Concept of the local-adaptation syndrome. In Fig. 1 we have indicated that nonspecific damage to a limited tissue area can influence the pituitary-adrenal system and consequently initiate systemic reactions to stress. It has long been known, furthermore, that many local responses to injury are nonspecific; it has been observed, for instance, that a variety of topical stressors (burns, microbes, drugs) share the power of producing local nonspecific tissue damage and/or inflammation. However, it is only recently that the close relationship between the systemic and local types of nonspecific reactions has been more clearly established. While the characteristic response of the body to systemic stress is the general-adaptation syndrome, which is characterized by manifold morphologic and functional changes throughout the organism, topical stress elicits a local adaptation syndrome, the principal repercussions of which are confined to the immediate vicinity of the eliciting injury. They consist, on the one hand, of degeneration, atrophy, and necrosis and, on the other hand, of inflammation, hypertrophy, hyperplasia, and, under certain conditions, even of neoplasia.

At first sight, there appears to be no striking similarity between the systemic and the local reaction types. A patient in traumatic shock furnishes a characteristic example of the general-adaptation syndrome and, in particular, of its earliest stage, the shock phase of the general alarm reaction. On the other hand, an abscess formed around a splinter of wood represents a typical example of the local-adaptation syndrome and, in particular, of its stage of resistance, during which the defensive inflammatory phenomena predominate. On the surface, these two instances of disease reveal no striking similarities; yet more careful study shows them to be closely related: (i) both are nonspecific reactions, comprising damage and defense; (ii) both are triphasic (with systemic or local alarm, resistance, and exhaustion); (iii) both are singularly sensitive to the adaptive hormones (ACTH, STH, and corticoids); (iv) if the two reactions develop simultaneously in the same individual, they greatly influence each other—that is, systemic stress markedly alters tissue reactivity to local stress and vice versa.

The fundamental reaction pattern to topical stressors is a local-adaptation syndrome; to systemic stressors the fundamental reaction pattern is the general-adaptation syndrome. Various modifications of these two basic responses constitute the essence of most of the diseases known today.

Are There Diseases of Adaptation?

By diseases of adaptation, we mean maladies that are caused principally by errors in the adaptation syndrome. Thus we arrived at the conclusion that the pathogenicity of many systemic and local stressors depends largely on the function of the hypophysis-adrenocortical system. The latter may either enhance or mitigate the body's defense reactions against stressors. We think that derailments of this adaptive mechanism are the principal factors in the production of certain maladies, which we consider, therefore, to be essentially diseases of adaptation (*17*).

It must be kept in mind that such diseases of adaptation do not necessarily become manifest during exposure to stress. This is clearly demonstrated by the observation that temporary overdosage with desoxycorticosterone can initiate a self-sustaining hypertension, which eventually leads to death, long after hormone administration has been discontinued. Here, we speak of "metacorticoid" lesions. The possibility that a temporary excess of endogenous mineralocorticoids could in-

duce similar delayed maladies deserves serious consideration.

Among the derailments of the general-adaptation syndrome that may cause disease, the following are particularly important: (i) an absolute excess or deficiency in the amount of adaptive hormones (for example, corticoids, ACTH, and STH) produced during stress; (ii) an absolute excess or deficiency in the amount of adaptive hormones retained (or "fixed") by their peripheral target organs during stress; (iii) a disproportion in the relative secretion (or fixation) during stress of various antagonistic adaptive hormones (for example, ACTH and antiphlogistic corticoids, on the one hand, and STH and prophlogistic corticoids, on the other hand); (iv) the production by stress of metabolic derangements, which abnormally alter the target organ's response to adaptive hormones (through the phenomenon of "conditioning"); and (v) finally, we must not forget that, although the hypophysis-adrenal mechanism plays a prominent role in the general-adaptation syndrome, other organs that participate in the latter (for example, nervous system, liver, and kidney) may also respond abnormally and become the cause of disease during adaptation to stress.

With this in mind it may be convenient for investigative purposes to classify as "diseases of adaptation" those maladies in which an inadequacy of the adaptation syndrome plays a particularly important role. This means that the term should be used only when the maladaptation factor appears to be more important than the eliciting pathogen itself. No disease is purely a disease of adaptation, anymore than it could be purely a disease of the heart or an infectious disease, without overlap with other nosologic groups. Conversely, there is no disease in which adaptive phenomena play no part.

It is undoubtedly useful to realize, however, that some agents are virtually "unconditional pathogens," in that their influence on the tissues is so great that they cause damage almost irrespective of any sensitizing or adaptive factors (for example, immediate effect of x-rays or of severe thermal and mechanical injuries, and the actions of certain microorganisms to which everybody is susceptible.)

Most disease-producing agents, however, are to a greater or lesser extent "conditionally acting pathogens"; that is, their ability to produce illness is largely dependent on our adaptive reactions to them. Here, correct adaptation may prevent disease, (for instance, a focus of tuberculosis perfectly held in check by an appropriate inflammatory barricade), but insufficient or excessive adaptive reactions may themselves be what we experience as illness (excessive and unnecessary inflammation around an otherwise harmless allergen).

Application of Animal Experiments to Clinical Medicine

Since most of the fundamental work on stress had been performed on laboratory animals, it was reasonable to question its applicability to problems of clinical medicine. It may now be said, however, that although there are certain differences in the stress response of every species, the general pattern of reaction is essentially the same in the various kinds of experimental animals and in man. Furthermore, a good deal of evidence has accumulated in support of the view that the experimental similes of spontaneous diseases produced in animals by exposure to stress, or by overdosage with certain adaptive hormones, are closely related to the corresponding maladies of man.

Let us merely mention a few of the most striking similarities in the responses to stress and to adaptive hormones of animals and man.

Morphologic and functional adrenocortical changes during stress. There can be no doubt that, during intense stress (for example, severe mechanical or thermal injuries and massive infections), the adrenal cortex of man, just as that of laboratory animals, shows morphologic changes characteristic of hyperactivity. At the same time, there is a demonstrable increase in the blood concentration and urinary excretion of corticoids and their metabolites. The other manifestations (morphologic, functional, and chemical) of the stress syndrome also failed to exhibit any fundamental dissimilarity in the reaction patterns of animals and man.

Corticoid requirements during stress. During stress, the corticoid requirements of all mammals are far above normal. After destruction of the adrenals by disease (as after their surgical removal), the daily dose of corticoids, necessary for the maintenance of well-being at rest, is comparatively small, but it rises sharply during stress (for example, cold, intercurrent infections, and hemorrhage), both in experimental animals and in man.

Anti-inflammatory effects of corticoids. The same antiphlogistic corticoids (cortisone and cortisol) that were shown to inhibit various types of experimental inflammations in laboratory animals exert similar effects in a human being afflicted by inflammatory diseases (for example, rheumatoid arthritis, rheumatic fever, and allergic inflammations).

Sensitivity to infection after treatment with antiphlogistic corticoids. In experimental animals, the suppression of inflammation by antiphlogistic hormones is frequently accompanied by an increased sensitivity to infection, presumably because the encapsulation of microbial foci is less effective and perhaps partly also because serologic defense is diminished. Thus, even a species naturally resistant to the human type of tuberculosis, such as the rat, can contract this disease during overdosage with ACTH or cortisone. Similarly, in patients undergoing intense treatment with antiphlogistic hormones (for example, for rheumatoid arthritis), a previously latent tuberculous focus may suddenly spread. It is a well-known fact that in patients suffering from tuberculosis the disease is especially readily aggravated by exposure to any kind of stress situation. Rest cures have long been practiced in view of this. It is perhaps not too farfetched to consider the possibility that an increased ACTH and cortisol secretion during stress may play an important part in the development of clinical tuberculosis.

Sensitization to mineralocorticoids by sodium and the buffering effect of the adrenals. In experimental animals, mineralocorticoids tend to raise the blood pressure and to cause vascular and renal damage (nephrosis and nephrosclerosis) often with edema. This effect is aggravated by simultaneous treatment with sodium chloride and becomes particularly severe after adrenalectomy. Similarly, in man on a high sodium intake, and especially after adrenalectomy, otherwise nontoxic doses of desoxycorticosterone will produce hypertension and edema. Apparently, in man as in the laboratory animal, sodium acts as a conditioning factor for mineralocorticoids, while the adrenal exerts a buffering effect.

This may also explain why, in many cases of clinical hypertension, bilateral adrenalectomy exerts a beneficial effect, as long as only cortisone or cortisol is used for substitution therapy, while treatment with desoxycorticosterone restores or further aggravates the hypertensive disease. Apparently, the adrenals of these patients produce some desoxycorticosteronelike factor that plays at least an adjuvant role in the pathogenesis of hypertension.

In patients suffering from rheumatoid arthritis, adrenalectomy has also been reported to exert a beneficial influence if only glucocorticoids are used for maintenance. Furthermore desoxycorticosterone tends to elicit arthritic changes only in the adrenal-deficient but not in the intact patient. This effect of desoxycorticosterone is, in turn, corrected by simultaneous cortisone treatment.

Finally, let us point out that, both in man and in animals, the various charac-

teristic effects of cortisone are also obtained at especially low dose levels after adrenalectomy.

Psychological and psychiatric effects of corticoid overdosage. Considerable attention has been given of late to the possible mental effects of stress and of the adaptive hormones. It would be beyond the scope of this article (and certainly outside my competence) to discuss these in detail, but a few remarks based on our experimental observations may be in order.

It has long been noted that various steroids—including desoxycorticosterone, cortisone, progesterone, and many others—can produce in a variety of animal species (even in primates such as the rhesus monkey) a state of great excitation followed by deep anesthesia. It has more recently been shown that such steroid anesthesia can also be produced in man, and, of course, the marked emotional changes (sometimes bordering on psychosis) that may occur in predisposed individuals during treatment with ACTH, cortisone, and cortisol are well known. Several laboratories reported furthermore that the electroshock threshold of experimental animals and their sensitivity to anesthetics can be affected by corticoids.

Thus, it appears very probable that corticoids secreted during stress also have an important influence on nervous and emotional reactions. Conversely, it is now definitely established that nervous stressors (pain and emotions) are particularly conducive to the development of the somatic manifestations of the stress syndrome; thus stress can both cause and be caused by mental reactions.

In conclusion, let us reemphasize that no illness is exclusively a disease of adaptation, but considerable evidence has accumulated in favor of the view that stress, and particularly the adaptive hormones produced during stress, exert an important regulating influence on the development of numerous maladies.

It is virtually certain that our concepts concerning the role of pituitary and corticoid hormones in the pathogenesis of certain diseases of adaptation will have to undergo modifications as more facts become known. However this is true with every theory. The same was true, for instance, of the original theory that related diabetes to a simple hypoinsulinism, when the role of the anterior pituitary was discovered. Yet, the realization of some pathogenic relationship between insulin and diabetes was an almost indispensable step in the subsequent development of this field.

The best theory is that which necessitates the minimum number of assumptions to unite the maximum number of facts, since such a theory is most likely to possess the power of assimilating new facts from the unknown without damage to its own structure. Our facts must be correct; our theories need not be if they help us to discover new facts, even if these discoveries necessitate some changes in the structure of the theory.

Meanwhile, the stress theory, as outlined in this article, permits us to correlate the known facts and furnishes a concrete plan for the systematic development of this field through planned investigation rather than through the mere empirical collection of chance observations.

Outlook

Pasteur, Koch, and their contemporaries introduced the concept of specificity into medicine, a concept that has proved to be of the greatest heuristic value up to the present time. Each individual, well-defined disease, they held, has its own specific cause. It has been claimed by many that Pasteur failed to recognize the importance of the "terrain," because he was too preoccupied with the pathogen (microorganism) itself. His work on induced immunity shows that this is incorrect. Indeed, at the end of his life he allegedly said, "Le microbe n'est rien, le terrain est tout."

The theory that directed the most fruitful investigations of Pasteur and his followers was that the organism can develop specific adaptive reactions against individual pathogens and that by imitating and complementing these, whenever they are short of optimal, we can treat many of the diseases that are caused by specific pathogens.

To my mind, the general-adaptation syndrome represents, in a sense, the negative counterpart, or mirror image, of this concept. It holds that many diseases have no single cause, no specific pathogen, but are largely due to nonspecific stress and to pathogenic situations that result from inappropriate responses to such nonspecific stress.

Our blueprint of the pathways through which stress acts may be partly incorrect; it is certainly quite incomplete. But in it we have a basis for the objective scientific dissection of such time-honored, but hitherto rather vague, concepts as the role of "reactivity," "constitution and resistance," or "nonspecific therapy," in the genesis and treatment of disease.

If I may venture a prediction, I would like to reiterate my opinion that research on stress will be most fruitful if it is guided by the principle that we must learn to imitate—and if necessary to correct and complement—the body's own autopharmacologic efforts to combat the stress factor in disease.

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No university is worthy of the name, that does not do everything in its power to promote original research in its laboratories. It is the duty of the university to see that its professors and teachers are not overburdened with routine teaching, but are given time for investigation and provided with research laboratory facilities and the necessary funds for this purpose.—E. RUTHERFORD.

Pioneer in International Plant Quarantine Work

A personality symbolic of 40 years' progress in international plant quarantine activities was lost to the official Washington scene with the passing on 7 July of Ernest Ralph Sasscer at the age of 71.

His half-century career in the U.S. Department of Agriculture is epitomized in the citation accompanying the distinguished service award he received from the department in 1953: "For inspirational leadership in planning, organizing, and directing the Department's activities against the entry and spread of plant pests, thereby adding to the Department's prestige at home and abroad." This highest attainable departmental award was probably his most cherished recognition.

Born in Waldorf, Maryland, 23 October 1883, Sasscer received his secondary-school education at McDonough Institute, LaPlata, Maryland. He obtained his B.S. degree at the Maryland Agricultural College (now the University of Maryland) in 1904 and his M.S. degree there in 1913. He was employed during the summer of 1904 as a nursery inspector by the Maryland Experiment Station. On 21 October 1904 he was appointed a scientific aide in the old U.S. Bureau of Entomology, where he specialized in the taxonomy of the scale insects. Thereafter his entire professional career was spent in the U.S. Department of Agriculture.

There were three fields in which Sasscer made his major contributions. First, was his recognition of the danger to American agriculture of foreign plant pests arriving in imported plant materials, and his pioneer work in developing the department's foreign plant quarantine program. As a result of this recognition he led in developing an international consciousness of the need for world-wide plant quarantine protection. He succeeded in stimulating uniformity and high standards in international plant protection safeguards. Much of his success in this field was due to his integrity and the respect in which he was held by plant quarantine officials in other countries. This international service was recognized by Queen Juliana of the Netherlands on 9 November 1953, when she conferred on him the Officer's Cross of the Order of the House of Orange-Nassau. In 1954, King Baudouin of Belgium named him an officer of the Order of the Crown.

Another major field was his development of vacuum fumigation as a means of destroying insects on plants and plant products. This pioneer work expanded into modern plant quarantine fumigation procedures.

Also, under his direction, the function of the plant quarantine inspector was transformed from something of a police-like role to that of a highly trained professional specialist. This Sasscer accomplished by emphasizing in-service training, so that many of his men became specialists in entomology, plant pathology, and botany, with special emphasis on the plant quarantine aspects of these sciences. He was a great morale builder and greatly increased the effectiveness of the plant quarantine program through the weight of his own personality and sincere interest in his men.

A congenial companion, he had a keen sense of humor and was skilled at repartee. He enlivened his talks with apt anecdotes. He was impatient with the red tape in which the promulgation of plant quarantines became enmeshed in the past decade.

Following his original appointment in 1904, Sasscer quickly advanced to positions of increasing responsibility. He became a scientific assistant in 1906, chief inspector of the Federal Horticultural Board in 1912, and entomologist and executive officer of the board in 1924. During these years he was the author of many publications on scale insects and vacuum fumigation. In 1928 he was appointed head entomologist in charge of the Division of Foreign Plant Quarantines, Bureau of Entomology and Plant Quarantine, in which office he continued until his retirement in October 1953.

In 1951, Sasscer was a member of the United States delegation to the conference called by the Food and Agricultural Organization of the United Nations at The Hague. The conference worked out the final draft of the International Plant Protection Convention, a treaty now in effect.

Sasscer was a past president of the American Association of Economic Entomologists (1939) and the Entomological Society of Washington (1918, 1919) a fellow of the American Association for the Advancement of Science, and a member of several other scientific and professional organizations.

AVERY S. HOYT
Agricultural Research Service,
U.S. Department of Agriculture,
Washington, D.C.

Our present era is characterized by something new in the life of man, and that is the impact of science and applied science or technology on our lives. However, our ultimate goal is not science, just for science's sake; our goal is a higher degree of culture and civilization. We should realize that science is not the measure of civilization—science and technology are merely tools, not ends in themselves.—GASTON F. DU BOIS.

News of Science

Commission on Mental Illness

A Joint Commission on Mental Illness and Health has been organized to carry out the provisions of the Mental Health Study Act of 1955 (Public Law 182). Leo H. Bartemeier, psychiatrist of Baltimore, Md., is chairman of the trustees of the new organization. The act calls for a nation-wide "analysis and reevaluation of the human and economic problems of mental illness," to be carried out by one or more qualified nongovernmental organizations. The Congress passed the act this past session without a dissenting vote in either house.

The act authorizes appropriations of $1.25 million over 3 years, of which $250,000 has been appropriated for the first year. The money is assigned to the Surgeon General of the U.S. Public Health Service, who may grant it to nongovernmental organizations to carry out the study. Private monies may also be used. The act requires that such organizations file annual reports and a final report with the Congress, the Surgeon General, and state governors.

Bartemeier has expressed the hope that the Surgeon General would at the proper time approve the application of the Joint Commission on Mental Illness and Health as the qualified organization to execute the provisions of the Mental Health Study Act. He has pointed out that the joint commission is comprised of representatives of the leading national organizations and agencies that have a primary interest in the mental health field. Many other organizations with related interests will also be asked to participate in the work.

There has never been a thoroughgoing national study and report on all aspects of the resources, methods, and practices for diagnosing, treating, caring for, and rehabilitating the mentally ill. The joint commission was incorporated in August in the District of Columbia by a small group comprised of representatives of the American Association of Psychiatric Social Workers, American Hospital Association, American Medical Association, American Nurses Association and the National League for Nursing, American Psychiatric Association, American Psychological Association, and the National Education Association. Daniel Blain, medical director of the American Psychiatric Association, Washington, D.C., is acting executive director for the commission, and Richard J. Plunkett, secretary of the Council on Mental Health of the American Medical Association, Chicago, Ill., is acting deputy executive director.

The following have also been invited to serve as initial organizational members of the commission: American Association on Mental Deficiency, American Association of Psychiatric Clinics for Children, American Bar Association, American Occupational Therapy Association, American Public Health Association, Council of State Governments, Joint Commission on Accreditation of Hospitals, National Association for Mental Health, National Institute of Mental Health, National Rehabilitation Association, Social Science Research Council, the U.S. Children's Bureau and the Office of Vocational Rehabilitation of the Department of Health, Education, and Welfare, and the Veterans Administration. Still others will be asked as plans develop.

The first official meeting of the commission as a whole will be held in Washington, D.C., on 8 Oct. to elect officers and complete other organizational details. Shortly thereafter, an application for the grant will be submitted to the Surgeon General. If the latter acts favorably on the application, the joint commission will get the study underway before the end of the year.

News Briefs

■ The National Bureau of Standards recently developed a method for closely packing digital pulses on magnetic tape. This method promises future useful application in the field of electronic computers. Such high-density storage can greatly reduce problem solution time by providing more rapid access to information recorded on external magnetic tape units.

In a series of experiments performed by J. R. Sorrells of the data-processing laboratory, both continuous-current and pulse techniques were investigated to achieve densities in the range of 500 to 700 pulses per inch. Recording and reading circuitry was also developed to provide large-amplitude playback signals with error-free differentiation between binary *ones* and *zeroes*.

An integral part of many large high-speed electronic computers is some type of magnetic tape or wire storage system that serves as an input-output means, as an external low-speed memory, or in some cases as both. Many types of mathematical problems require extensive external storage. In solving these problems relatively little actual computation is performed, but a great many data must be handled and assimilated by the computer. Ideally, a magnetic tape system should supply or receive data from the machine fast enough so that the computer can proceed with the problem solution at its usual rate.

In reality, however, the maximum rate at which the tape can accommodate information is usually very slow compared with the machine's internal speed, because tape velocity is limited and information is commonly stored on the tape at comparatively low density. As a consequence, the majority of problem-solution time is not spent in computation but in the performance of input-output or tape storage operations.

The bureau's investigation has been directed toward improving magnetic tape storage techniques. Such developments would permit more rapid transmission of information to the computer by increasing the number of digital pulses recorded on each inch of the tape, thereby increasing the over-all efficiency of the machine. Already in operation with the NBS electronic computer, SEAC, are tape drive units that provide high-speed starting, stopping, and reversing of magnetic tapes, together with maximum practical tape speeds.

■ The first half of the July number of *Reviews of Modern Physics*, vol. 27, No. 3, is devoted to the memorial symposium held in honor of Enrico Fermi at the Washington meeting of the American Physical Society, 29 Apr. 1955, with H. A. Bethe presiding. The paper by F. Seitz deals with Fermi statistics and its applications. E. J. Konopinski discusses "Fermi's theory of beta decay"; Emilio Segrè gives a vivid and fascinating account of Fermi's Rome period in "Fermi and neutron physics"; Walter H. Zinn, one of Fermi's collaborators in reactor development, writes on "Fermi and atomic energy"; and H. L. Anderson describes some of Fermi's later experimental work in the final paper, "Meson experiments with Enrico Fermi." Although most of the papers are addressed to an audience of physicists, nonphysicists may also read with interest the articles by Segrè and Zinn.

Supplement to *Nuove Cimento*, vol. 2,

ser. 10, summer 1955, is also dedicated to Fermi. The part, "Physics of elementary particles," contains lectures on "Pions and nucleons" given by Fermi at a meeting in Varenna, July–August 1954.

■ The Canadian Government has offered an NRX atomic reactor to India under the Colombo Plan; the offer has been accepted. A team of Indian scientists, including H. J. Bhabha, head of the Indian Department of Atomic Energy, will soon visit Canada for discussions with Canadian scientists and government officials. A bilateral agreement will be worked out covering arrangements for the project.

In accepting the reactor, Prime Minister Nehru indicated that his government would be prepared to allow accredited foreign scientists, including those from other Colombo Plan countries in south and southeast Asia, to use the facilities that will be available at the atomic energy center in India where the reactor will be located.

■ Perspiration when it first appears on the skin has no odor and is sterile. In a recent report to the Society of Cosmetic Chemists, Walter B. Shelley of the University of Pennsylvania stated that contamination of sweat with the bacteria ordinarily found on the skin gives it "the distinctive apocrine odor of the axilla." Recent discovery of a way to collect relatively pure perspiration made these findings possible.

Association Finances

Condensed statements of Association finances for the year 1954, prepared by the auditing firm of G. P. Graham & Company, are published herewith, in order that the entire membership may be fully informed regarding the financial operations, obligations, and resources of the AAAS.

The first two statements summarize operating receipts and expenditures. The final annuity payments to the Cattell estates for *Science* were drawn from the excess of receipts over expenditures in the operating account. Total annuity and inflation clause payments amounted to $269,832.82.

The last two statements summarize the status of investment and trust funds. The value of investments and the amount of investment income both increased in 1954, thanks to sound investment policies and management, but the total endowment is still meager in comparison with the magnitude of the responsibility the Association should assume in advancing science.

HANS NUSSBAUM
Business Manager, AAAS

Washington 5, D.C., May 26, 1955

To the Council of the American Association for the Advancement of Science
Washington, D.C.

We have examined the balance sheet of the Operating Fund of the American Association for the Advancement of Science as at December 31, 1954, and the statement of revenue and expenditures for the year then ended. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

In our opinion, the accompanying statements present fairly the financial position of the Operating Fund of the American Association for the Advancement of Science as at December 31, 1954, and the results of its operations for the year then ended.

G. P. GRAHAM & COMPANY
By G. R. Bowers

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE OPERATING FUND
BALANCE SHEET AS AT DECEMBER 31, 1954

Assets

Current assets		
Cash in banks	$220,146.70	
Accounts receivable	16,170.11	
U.S. Treasury bills	483,856.85	
Certificates of deposit	250,000.00	$970,173.66
Other assets		
Deposit with airline		425.00
		$970,598.66

Liabilities

Current liabilities		
Accounts payable	$ 57,298.73	
Due to the Treasurer's account—AAAS	26,636.94	
Balance of grant—Arid Lands Symposium	6,833.48	$ 90,769.15
Deferred income		
Prepaid dues and fees	$218,752.58	
Prepaid journal subscriptions	50,967.71	269,720.29
Reserve fund		250,000.00
Unallocated funds		
Balance January 1, 1954	$315,459.41	
Add: Excess of revenue over expenditures	44,649.81	
Balance December 31, 1954		360,109.22
		$970,598.66

STATEMENT OF REVENUE AND EXPENDITURES FOR THE YEAR ENDED DECEMBER 31, 1954

Revenue			
Dues and entrance fees			$284,466.51
Journals			
Subscriptions			
From Treasurer's accounts (Life, 50-year and emeritus members)	$ 3,339.00		
Members special subscriptions	18,858.20		
Nonmembers subscriptions	62,086.57	$ 84,283.77	
Advertising		153,513.07	
Miscellaneous sales		2,730.76	240,527.60
Publications			
Binders		$ 1,878.25	
Symposium volumes		14,990.43	16,868.68
Berkeley meeting and exhibit			43,271.88
Rental income			6,107.48
Income from investments			12,448.89
Miscellaneous			6,701.55
			$610,392.59
Expenditures			
Administrative and general expense		$ 79,508.30	
Building expense		9,232.67	
Board of directors		8,752.43	
Other committees		2,526.66	
Allowance to divisions		7,279.00	
Section expense		7,720.28	
Circularization—new members		10,117.19	
Meetings and exhibits		38,596.69	
Journals		364,954.79	
Publications		27,662:22	
Employees' retirement plan		5,101.87	
Social security		2,184.32	
Miscellaneous		339.23	
Annuity			
1954 Science annuity	$ 924.91		
Inflation allowance on annuity	842.22	1,767.13	565,742.78
Excess of revenue over expenditures			$ 44,649.81

Washington 5, D.C.
May 26, 1955

To the Council of the American Association for the Advancement of Science
Washington, D.C.

We have examined the balance sheet of the Treasurer's accounts of the American Association for the Advancement of Science as at December 31, 1954, and the statement of cash receipts and disbursements for the year then ended. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as are considered necessary in the circumstances.

In our opinion, the accompanying financial statements present fairly the financial position of the Treasurer's accounts of the American Association for the Advancement of Science as at December 31, 1954, and the cash receipts and disbursements for the year then ended.

G. P. GRAHAM & COMPANY
By G. R. Bowers

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE TREASURER'S ACCOUNTS
BALANCE SHEET AS AT DECEMBER 31, 1954

Assets

Endowment funds			
Cash in bank		$ 3,343.29	
Advanced to Gordon Research Conferences		9,465.45	
Securities—at cost		356,359.14	$369,167.88
Building fund			
Due from Operating Fund		$ 26,636.94	
Real Estate		153,297.20	179,934.14
			$549,102.02

Liabilities and Reserves

Endowment funds			
For research		$172,982.18	
For general purposes		150,776.36	
For special purposes		38,872.33	
Liabilities			
Academy grants	$3,253.51		
Special academy grants	275.00		
Sociology prize fund	3,000.00		
AAAS—UNESCO fellowship fund	8.50	6,537.01	$369,167.88
Building fund			179,934.14
			$549,102.02

STATEMENT OF CASH RECEIPTS AND DISBURSEMENTS
FOR THE YEAR ENDED DECEMBER 31, 1954

Cash balance January 1, 1954			$ 14,305.30
Receipts			
Income from investments		$ 16,873.23	
Redemption and sale of securities		436,590.15	
Life membership fees		3,600.00	
Gifts		132.00	
Special academy grants		525.00	
Deceased emeritus life membership fees		1,400.00	459,120.38
			$473,425.68
Disbursements			
Income from investments			
Allocated to building fund	$ 632.37		
Allocated to Gordon Research Conferences	1,045.88	$ 1,678.25	
Securities purchased		419,871.05	
Newcomb Cleveland prize		1,000.00	
Academy grants		4,501.50	
Special academy grants		800.00	
Emeritus life membership fees (From Jane M. Smith fund)		1,200.00	
Fees of deceased emeritus life members (To Jane M. Smith fund)		1,400.00	
Journal subscriptions (Life, 50-year and emeritus members)		3,339.00	
Expenses		521.15	
AAAS—UNESCO fellowship fund transferred or refunded		45.00	
Westinghouse Award balance refunded		279.58	
Building fund cash transferred to operating fund		25,981.41	
Advanced to Gordon Research Conferences		9,465.45	470,082.39
Cash balance December 31, 1954			$ 3,343.29

Scientists in the News

JAMES D. EBERT, professor of zoology at Indiana University, is to succeed GEORGE W. CORNER as director of the department of embryology at the Carnegie Institution of Washington, effective 1 Jan. 1956. The department, which is located in Baltimore, Md., is concerned with investigations of the morphology of the human embryo and the comparative physiology of the reproductive system. The morphological research has centered about the department's collection of human embryos.

Ebert's research program has been directed toward an understanding of the mechanism of synthesis and interaction of tissue-specific proteins in development. He has employed the techniques of immunochemistry in studies that have helped to throw light on the processes involved in the formation and localization of the contractile proteins, actin and myosin, in the developing heart. Recently he has coupled this approach with an analysis of the metabolism of the heart-forming regions of the early embryo, paying special attention to the mitochondria and their role in fibrogenesis. Since 1952 he has combined the classical methods of experimental embryology—transplantation, organ culture, and so forth—with radiobiological techniques in an investigation of the growth-regulating mechanisms of the chick embryo. These experiments suggest that, at the outset, growing organs can utilize specific macromolecules almost intact without breaking them down into simpler units.

Corner, who for more than 40 years has been engaged in significant fundamental research in the anatomy and physiology of mammalian and especially of primate reproduction, is also a recognized authority in the field of medical history. Upon retirement he will join the staff of the Rockefeller Institute for Medical Research, New York, as historian of the institute. He will write a history of its organization and activities and will also carry forward his previous work in fundamental research, acting as adviser and consultant to a small group of scientists investigating the physiology of reproduction.

The 1955 Howard W. Blakeslee awards for outstanding reporting in the field of heart and blood vessel diseases will be presented by the American Heart Association to the following:

FRANCES BURNS, medical editor of the *Boston Daily Globe*, for a series of 13 articles on heart research and advances in the treatment and prevention of cardiovascular diseases.

JANE STAFFORD, medical writer of Washington, D.C., for year-round coverage of important developments in the

cardiovascular field syndicated to newspapers and magazines by Science Service.

WILLIAM PETERS of Pelham Manor, N.Y., for his article, "A new heart for Pamela," published in the September 1954 issue of *Cosmopolitan* magazine. This article described a new technique in heart surgery in which the circulatory systems of a child and her father were linked so that surgeons could repair a defect in her heart.

The COLUMBIA BROADCASTING SYSTEM for the film, "Gate 27" which was telecast over the CBS-TV network as part of the series known as *The Search*. The film described the research being conducted at the Laboratory of Physiological Hygiene, University of Minnesota, on the relationship of diet, vocation, and other factors to heart and blood vessel diseases.

The awards, each bearing an honorarium of $500, will be presented at the AHA annual dinner, which is to take place in New Orleans, La., on 23 Oct., during the 31st annual meeting and 28th scientific sessions of the association, 22–28 Oct.

JOHN G. KIDD, professor of pathology, Cornell University Medical College, will deliver the 6th Augustus B. Wadsworth lecture at the Division of Laboratories and Research, New York State Department of Health, Albany, N.Y., on 27 Oct. He will speak on "Immunological approaches to the problems of cancer."

LISE MEITNER, head of the nuclear research department of the Mechanical-Scientific Academy in Stockholm, Sweden, recently received the Otto Hahn prize for chemistry and physics in Munich, Germany. Hahn was present at the ceremony.

CHARLES A. DAMBACH has been appointed professor and director of Ohio State University's new Natural Resources Institute. He has been on leave from the faculty since 1950 to serve as chief of the Wildlife Division in the State Department of Natural Resources. The institute was established in June to "stimulate and coordinate teaching and research in the conservation, development and wise use of natural resources."

FRANK PRESS, associate professor of geophysics at Columbia University, has joined the faculty of the California Institute of Technology as professor of geophysics. He is a specialist in seismology.

CLARENCE M. ABLOW, former research mathematician with Boeing Airplane Co., Seattle, Wash., has been appointed senior research mathematician in the engineering division of Stanford Research Institute. He will work in the radio systems laboratory.

NORMAN N. BARISH, of the department of industrial and management engineering, New York University College of Engineering, has been named chairman of the department.

VINCENT J. CUSHING, assistant manager of the propulsion and structural research department at the Armour Research Foundation of Illinois Institute of Technology, has been named manager. He will direct research and development in structural analysis, materials engineering, blast effects, hydrodynamics, and missiles and propulsion.

JOHN C. BUGHER, retiring director of the division of biology and medicine of the U.S. Atomic Energy Commission [*Science* **122**, 590 (30 Sept. 1955)], has received the AEC Distinguished Service award and the Superior Accomplishment award; the latter includes a cash award of $2000.

JOHN V. L. HOGAN, president of Hogan Laboratories, is to receive the Institute of Radio Engineers medal of honor, the highest technical award in the radio engineering profession. He is being honored "for his contributions to the electronic field as a founder and builder of the Institute of Radio Engineers, for the long sequence of his inventions, and for his continuing activity in the development of devices and systems useful in the communications art." The award will be presented during the IRE national convention in New York next March.

GLEN W. HEDRICK, an organic chemist who was formerly associated with the Dearborn Chemical Co., Chicago, Ill., has been appointed to the staff of the Naval Stores Station, Olustee, Fla. As supervisor of the new-products research unit, Hedrick will be responsible for directing studies leading toward the development of new or improved products from pine gum, turpentine, and rosin and of economical processes for their manufacture.

HARRY F. OLSON of the Radio Corp. of America has received the 1955 Samuel L. Warner memorial award of the Society of Motion Picture and Television Engineers. Olson, who is director of the R.C.A. Acoustical and Electro-mechanical Research Laboratory, Princeton, N.J., was honored for his productive career in audio engineering, including his work on the velocity microphone and the duocone speaker for high-fidelity sound reproduction, and for his contributions to the development and improvement of phonograph pickup and recording equipment, underwater sound equipment, and sound motion picture and public address systems.

FREDERICK E. TERMAN, dean of the Stanford School of Engineering and an authority in electronics, has been appointed provost of Stanford University. Terman, who will continue as engineering dean, succeeds Douglas M. Whitaker, who has resigned to become vice president for administration of the Rockefeller Institute for Medical Research in New York [*Science* **122**, 579 (12 Aug. 1955)].

RUDOLF PLANK, authority on refrigeration, has been named a visiting professor of mechanical engineering at Columbia University. In cooperation with Carl F. Kayan, head of the department, Plank will teach a course on "Contemporary problems of refrigeration and food preservation" during the fall semester.

Formerly a professor in the Institute of Technology at Karlsruhe, Germany, Plank founded there the Refrigeration and Food Preservation Institute. Plank has written many books and papers and he is the editor of a 12-volume *Encyclopedia of Refrigeration*, of which three volumes have so far been published.

FÉLIX GONZÁLES-BONORINO, formerly of the geologic branch of the Dirección Nacional de Minería of Argentina, has joined the staff of the geology department of the Missouri School of Mines as a visiting professor.

LUDWIK ANIGSTEIN, professor of preventive medicine and public health at the University of Texas Medical Branch, Galveston, has returned from an extensive tour of Peru and Brazil. He collected material pertaining to tropical diseases that will be used in the university's teaching program in tropical medicine. The trip was supported by the James McLaughlin fellowship in infection and immunity.

CLARK C. HERITAGE, a chemical engineer who has devoted more than 40 years to forest products and chemicals developments, retired on 1 Oct. as development director for the Weyerhaeuser Timber Co., Tacoma, Wash. He plans to establish his own office in Tacoma to serve industry in the establishment, planning, and execution of research and development programs.

The following appointments to assistant professor have been announced. Massachusetts Institute of Technology: NESMITH C. ANKENY, mathematics; EDWARD S. COHEN, chemical engineering; GEORGE F. KOSTER and GEORGE E. PUGH, physics. Woman's College of the University of North Carolina: DOUGLAS M. MCNAIR, ROBERT PENN, and ROBERT RADLOW, psychology. Pratt Institute: FRITZ C. WILDERMANN, physics.

California Institute of Technology has announced the appointment of the following research fellows:

TOYOKI KOGA is on leave from Nagoya University, Japan, where he is professor of engineering and director of the automatic control laboratory.

HERBERT RHINESMITH is on sabbatical leave from Allegheny College, Meadville, Pa., where he is associate professor of chemistry.

JOHN SEDDON, previously with the Royal Aircraft Establishment, England, is joining the institute on a Commonwealth fellowship in aeronautics.

LLOYD S. SHAPLEY has been a senior research investigator with the Rand Corporation, Santa Monica, Calif.

Necrology

ROBERT H. HALSEY, New York, N.Y.; 82; heart specialist and a professor of medicine at Columbia University Postgraduate Medical School, 1917–39; since 1939, a consultant to Goldwater Memorial Hospital; one of the founders of the American Heart Association and its president 1932–33; 15 Sept.

REYNOLDS L. HAAS, Ann Arbor, Mich.; 41; associate professor of obstetrics and gynecology at the University of Michigan Medical School; 20 Sept.

ABRAHAM LEVINSON, Chicago, Ill.; 67; expert on mental retardation in children, professor of pediatrics at Northwestern University Medical School, and author of a number of widely used textbooks; 17 Sept.

JOHN M. MELICK, Cresskill, N.J.; 62; engineer at Bell Telephone Laboratories, New York; designer of military equipment and devices, contributor to rocket development and the Nike guided missile network; 18 Sept.

EDWARD NELSON, Arlington, Va.; 64; communications specialist, scientific chief of research and development of the Army Signal Corp; 21 Sept.

JOHN POTZGER, Indianapolis, Ind.; 69; specialist in paleobotany and forest history, professor and head of the botany department at Butler University; a former president of the Ecological Society of America and its 1955 representative to the AAAS council; 18 Sept.

DONALD REDDICK, Gainesville, Fla.; 62; emeritus professor of plant pathology at Cornell University; 2 Apr.

FREDERICK D. RICHEY, Knoxville, Tenn., 71, geneticist and for 37 years a member of the U.S. Department of Agriculture, 11 Sept.

CHARLES SOLOMON, Brooklyn, N.Y.; 59; specialist in internal medicine and a drug expert; professor at New York University Medical College, lecturer at Long Island College of Medicine and New York State University College of Medicine, and a member of the advisory commission of *U.S. Pharmacopoeia*; 15 Sept.

D. H. UDALL, Ithaca, N.Y., 81, emeritus professor of veterinary medicine at Cornell University, 9 Sept.

MATHILDA K. WALLIN, Elmsford, N.Y.; 97; physician and since 1916 a member of the executive committee of the American Women's Hospitals; 21 Sept.

Education

■ A new physical sciences building to house the departments of astronomy, mathematics, and meteorology is under construction at the University of California, Los Angeles. Located at the north end of the Court of Sciences, the $1,700,000 L-shaped structure will be connected to the Engineering-Physical Science Building No. 2, for which funds were recently provided. Expected completion date of the Physical Sciences Building is January 1957.

The new building will give the departments of astronomy, mathematics, and meteorology a teaching and research facility containing 18 classrooms, 18 laboratories, 13 office-laboratories, 51 faculty offices, 3 seminar and conference rooms, and a first floor lecture hall capable of seating 127 persons.

■ New research laboratories for the study of diseases of the lungs, heart, kidneys, and blood vessels are to be established by Northwestern University Medical School. Plans call for specially designed and equipped laboratories, examination and treatment rooms, and facilities for nursing care and social service on the third floor of the Montgomery Ward Memorial Building at the university's Medical Center in Chicago.

Chest and circulatory diseases are leading causes of death in this country, claiming more than 750,000 lives each year. The new medical unit will be devoted to research studies designed to advance understanding of these diseases, education to provide physicians with new knowledge to fight them, and improved treatment to aid those who are afflicted. Patients will be studied in the clinic as outpatients. This will make it possible to study chronic diseases in an early stage and to follow a patient's progress for years if necessary.

Special equipment for diagnosis and research will include a treadmill, used in testing the efficiency of heart and lung function under varying degrees of rest, exercise, and stress. Oxygen consumption is measured from collections of the air that the subject breathes while exercising. Equipment will also include electrocardiographs, a ballistocardiograph, x-ray and fluoroscope units, and heart catheterization equipment.

■ The F. W. Olin Science Building at Bucknell University was dedicated on 28 Sept., when Charles L. Horn, president of the Olin Foundation, formally presented the building to the university. A $900,000 gift from Olin made the new structure possible; it will house the departments of chemistry, mathematics, and physics.

Principal speaker for the occasion was JOHN C. WARNER, president of Carnegie Institute of Technology, who also was awarded an honorary degree. Other degree recipients were ROBERT B. WOODWARD of Harvard University; LEONARD W. LABAREE of Yale University; HAROLD K. SCHILLING of the Pennsylvania State University; RAYMOND L. WILDER of the University of Michigan; and RAY G. DAGGS of the Army Medical Research Laboratory at Fort Knox, Ky.

Grants, Fellowships, and Awards

■ The National Academy of Sciences–National Research Council is prepared to award a limited number of senior postdoctoral fellowships in physiological psychology beginning this year. These awards, which are made possible by the generosity of the Carnegie Corporation of New York, will be for a period of 1 year. They are renewable. Stipends will be appropriate to the candidate's academic qualifications and will in general parallel those in other, advanced postdoctoral programs.

The principal objective of the new senior-fellowship program is to stimulate wider development and correlation of knowledge in physiological psychology. One approach to this goal consists of increasing the number of investigators who are qualified to pursue research in physiological psychology because of their familiarity and proficiency in more than one discipline. Another approach involves increasing the number of research centers in which this interdisciplinary research is supported and encouraged.

The senior fellowships are intended to enable young psychologists to spend 1 or 2 years in an environment where physiological research is in progress and where contact with nonpsychologists, expert in their own fields, will be maximized. Of equal importance will be the support of young physiologists who wish to spend the period of their fellowships in a working relationship with psychological investigators. The sponsors of the program hope in this manner the techniques and points of view of the psychologist will be made familiar to a growing number of physiologically oriented groups, and that at the same time modern physiological methods and theories will become a part of the thinking of more and more research psychologists.

Because it is hoped that the program will have an influence on both the fellows and the staffs of the laboratories to which they go, special attention will be given to the qualifications of each applicant and his actual and potential contributions to the field. The ideal fellow is one capable of acting as a "catalytic agent" in stimulating interdisciplinary thinking and research.

Candidates should be individuals of sufficient maturity and research productivity to function independently, although not in isolation, in the laboratory where they serve as fellows. It is expected that the majority of candidates will be at or near the level of assistant professor, but any individual holding a doctor's degree is eligible.

The new fellowships will be administered by a special board, which is presently constituted as follows: Frank A. Beach, Yale University, *chairman*; H. K. Hartline, Rockefeller Institute; Horace Magoun, School of Medicine, University of California at Los Angeles; Karl Pribram, Institute of Living, Hartford, Conn.; Eliot Stellar, Institute of Neurological Sciences, School of Medicine, University of Pennsylvania; S. S. Stevens, Harvard University; Harry Harlow, University of Wisconsin (ex officio); Paul Weiss, Rockefeller Institute (ex officio).

Direct applications for senior fellowships in physiological psychology will not be accepted. Instead, senior scientists are invited to nominate candidates for a fellowship. The nomination should include a record of the candidate's training, experience, and research activities. A sponsor should indicate his reasons for believing that the candidate is qualified for a fellowship, why the particular laboratory that has been selected is the best place for the candidate to serve his fellowship, and why his problem area is suited to interdisciplinary research. It is not essential that a specific laboratory be designated, but this is desirable whenever possible.

The board would also like to have the names of other senior workers who could evaluate the candidate independently. Subsequently the board may request additional information either from the sponsor or from the candidate. All communications concerning the program should be addressed to Physiological Psychology Fellowship Board, NAS–NRC, 2101 Constitution Ave., Washington 25, D.C.

■ Research grants and research fellowships in the field of nursing are available from the U.S. Public Health Service, Department of Health, Education, and Welfare. A total of $625,000 was appropriated by the Congress to support these awards. Previously, grants for research in nursing were made in limited numbers from non-earmarked funds that were available for general medical research.

The expanded program of grants and fellowships is designed to support investigations into ways and means of improving the quality of nursing care, training nurses in research methods applicable to nursing problems, and making better use of the limited supply of professional nurses. The grants in most cases will be made directly to universities, hospitals, health agencies, or professional groups, under whose auspices the research projects will be carried out.

The fellowships will be offered only to nurses who wish to receive special postgraduate training in research methods. Fellowships may be used for graduate research study in universities or for research training provided by any health agency or research center.

To be accepted for a fellowship, a nurse must be sponsored by the university or agency where the training will be given. Applications may be submitted to the Division of Research Grants, National Institutes of Health, Bethesda 14, Md.

■ Appropriations for grants-in-aid of research by the National Vitamin Foundation during 1954 amounted to $151,333.33, and those for educational purposes amounted to $21,330.99, a total of $172,664.32. In reporting these figures to the board of governors of the foundation, Robert S. Goodhart, scientific director, pointed out that the science of nutrition is opening new avenues of treatment in such widely diverse conditions as irradiation effects, emotional stress, cancer, pregnancy, diseases of the aged, obesity, chemical poisoning, and chronic degenerative diseases. Goodhart commented that "Results of Foundation supported projects that have proven to be of considerable practical importance include, among others, evidence that vitamin B_{12}, vitamin B_6, folic acid and pantothenic acid are dietary essentials for man; considerable progress toward the elucidation of the symptomatology of deficiencies of these vitamins and of their places in the therapy of a variety of conditions in man and animals; proof of the importance of adequate nutrition with vitamins and protein during pregnancy and of the pernicious effects of obesity or underweight on the course of pregnancy; major advances toward the understanding of the part played by intrinsic factor in vitamin B_{12} metabolism; understanding of the importance of the time element in the efficient utilization of amino acids; demonstration of the prevalence of chronic deficiencies of vitamin A, vitamin C, riboflavin and niacin, and the response of such deficiencies to adequate vitamin therapy continued over a sufficient period of time. Work now in progress promises to demonstrate the importance of vitamin E in human nutrition."

■ The American Psychiatric Association and the Smith, Kline and French Foundation of Philadelphia have announced the initiation of a 3-year fellowship program designed to provide staff psychiatrists in public mental hospitals and in schools for the retarded with new knowledge of therapies, techniques, and practices. Six to 12 fellowships will be awarded yearly beginning on 15 Nov. Grants will vary according to individual situations but in general will not exceed $600 per month. A committee of eight psychiatrists is now accepting applications for these grants. The committee chairman is Kenneth Appel, head of the department of psychiatry at the University of Pennsylvania School of Medicine.

The program is expected to stimulate research activity as well as to help overcome the serious lag between development of psychiatric skills in medical centers and their application in "backwater areas." It is anticipated also that the fellowship grants will encourage matching financial support by communities and states so that research in mental disease may be accelerated.

The Smith, Kline and French Foundation has already made an initial contribution of $30,000 to cover the first year's operation of this program. At least $90,000 will be expended for fellowships during the next 3 years.

An applicant's fellowship project may include education, training, and experience in any of a number of specialties, for example, hospital administration, biochemistry, physiology, group psychotherapy, chemotherapy, family care programs, rehabilitation techniques, treatment of emotionally disturbed children, operation of mental hospital outpatient clinics.

Applications should be in the hands of the fellowship committee by 1 Nov. Members will meet regularly to consider applications on 1 Nov. and 1 May each year. For information, write to the Smith, Kline and French Foundation Fellowship Committee, American Psychiatric Association, 1785 Massachusetts Ave., NW, Washington 6, D.C.

■ John M. Russell, executive director of the John and Mary R. Markle Foundation, 511 Fifth Ave., N.Y., has announced that the fund will continue for the ninth year its program of 5-year grants for medical school faculty members who are planning careers in academic medicine. During the 8 years of the program the fund has appropriated a total of $4,600,000 toward the support

of 158 doctors in 66 medical schools in the United States and Canada. The number of Markle scholars appointed annually has varied from 13 to 25; approximately 20 appointments will be made in 1956.

The dean of every medical school in the United States and Canada is invited to nominate a candidate *on or before 1 Dec.* The grants will be made at the rate of $6000 annually to the medical school where the scholar will teach and conduct research. A publication outlining the plan is available on request from the foundation.

In the Laboratories

■ The Borden Co.'s chemical division has announced plans to build a synthetic resin manufacturing plant in Manila to meet the Philippine plywood industry's need for adhesives. The first such plant in the Philippines, the new facility is to be incorporated as the Casco Chemical Co.

■ Bio-Basic, Inc., is a new organization that will be concerned with the application of scientific advances to problems in the food and pharmaceutical field. The firm intends to engage in development, manufacturing, and consulting work. Its initial effort will be devoted to improved dermatological preparations.

■ A regulation defining the scope, procedure, and limitations of the authority of advisory boards established by the Atomic Energy Commission has been issued. The Atomic Energy Act of 1954 gives the AEC authority to appoint boards to advise with, and make recommendations to, the commission on legislation, policies, administration, research, and other matters.

The new regulation is based on recommendations of the Attorney General concerning regulatory controls to be maintained by Government agencies over industry advisory committees in order to minimize the possibility of violation of antitrust laws.

■ The Gulf Oil Corp. has announced plans for a nuclear science laboratory that is to be located at the company's research center in Harmarville, Pa. Principal unit in the laboratory will be a 3-million-volt Van de Graaff particle accelerator that is being built by High Voltage Engineering Corp., Cambridge, Mass. The unit will be installed by approximately 1 Sept. 1956.

■ During each 5-year period since 1930, the count of x-ray analysis installations has at least doubled, according to questionnaires submitted in a nationwide survey sponsored by the educational department of North American Philips Co., Inc. Only 1.2 percent of the installations on the 1955 count existed prior to 1930, 4.8 percent prior to 1935, 8.5 percent prior to 1940, 21.9 percent prior to 1945, and 42.6 percent prior to 1950.

The survey was initiated as an educational project about a year ago in order to provide a source of up-to-date information for those concerned with various x-ray analysis techniques. The roster includes not only users of Norelco equipment but also those who employ instruments made by other manufacturers; some 35 companies have reported data.

To date, the survey also tabulates 40 private and government research laboratories and universities where work involves vital and difficult industrial projects.

A summary giving partial information gathered so far has been distributed to all contributing organizations. Others who have not yet filled out a questionnaire and who wish to be properly registered in the survey are urged to write for a copy by addressing a letter or card to C. J. Woods, 750 S. Fulton Ave., Mount Vernon, N.Y.

Many organizations have furnished extensive lists of papers that have been published by their personnel on x-ray analysis subjects. If and when the survey includes the majority of users in the United States and Canada, it may be possible to publish all of the information in a volume of "Who's Who in X-ray Analysis."

■ In commemoration of the one millionth rat born since the founding of its animal colony in 1923, Foster D. Snell, Inc., New York, has published a booklet, *Rats for Research*. The booklet describes the Snell-Supplee colony of albino rats, Wistar strain, which was purchased 5 years ago from the estate of George Cornell Supplee.

The late Dr. Supplee, a biochemist, established the colony from the Wistar strain in 1923. The colony has been operated as the Supplee Division of Foster D. Snell, Inc., since 1950. Copies of the booklet are available from the Public Relations Department, Foster D. Snell, Inc., 29 W. 15 St., New York 11.

Miscellaneous

■ A competitive examination for appointment of sanitary engineer officers to the regular corps of the U.S. Public Health Service will be held in various places throughout the country on 10, 11, and 12 Jan. 1956. Appointments provide opportunities for career service in sanitary engineering, including research. They will be made in the ranks of junior assistant, assistant, and senior assistant grades. Entrance pay, including dependency allotments, ranges from $4268 to $6017.

Application forms may be obtained by writing to the Chief, Division of Personnel, U.S. Public Health Service, Department of Health, Education, and Welfare, Washington 25, D.C. Completed application forms *must be received by 9 Dec.*

■ *Critical Years Ahead in Science Teaching* is again available for distribution without cost through the auspices of the Carnegie Corporation. Copies may be obtained by writing to Mr. Elbert C. Weaver, Phillips Academy, Andover, Mass. Self-addressed stickers for envelopes are appreciated.

■ The American Board of Nutrition will hold the next examinations for certification of specialists in human nutrition in April 1956. Applications for certification must be submitted *not later than 1 Feb. 1956*. Forms may be obtained from the secretary, Otto A. Bessey, Department of Biochemistry and Nutrition, University of Texas School of Medicine, Galveston, Tex.

■ The Indian Council on Ecological Research at the Forest Research Institute, Dehra Dun, is attempting to build an ecological library. The council trains teachers and postgraduate students in ecological research and offers facilities to research workers for carrying on original work.

An appeal is made to all ecologists, ecological societies, and publishers of ecological works to send as many publications as can be spared. Contributions will be gratefully received by the secretary of the council, Dr. G. S. Puri, Forest Research Institute, P. O. New Forest, Dehra Dun, India.

■ The articles in the October issue of *The Scientific Monthly* include "Equal temperament and the thirty-one-keyed organ," A. D. Fokker; "Soviet cosmology and Communist ideology," Maxim W. Mikulak; "Changing place of soils in agricultural production," Roy W. Simonson; "Are there rules for writing history of chemistry?" Aaron J. Ihde; "Mendel and the rediscovery of his work," Edward O. Dodson; and "How does rock break?" Fred C. Bond.

The letters in this issue are from Gerald C. Helmstadter, David M. Pratt, James C. Crumbaugh, Sherman Ross, and Ray C. Hackman. There are also the reviews of 18 books.

Erratum: In the issue of 16 Sept., page 526, the American Mathematical Society which will hold its 62nd annual meeting in Houston, Tex., on 27–29 Dec. was incorrectly listed as the American Meteorological Society.

Reports and Letters

Notation for Hemoglobin Types and Genes Controlling Their Synthesis

For the sake of precision in discussions of genetics, such as that held recently at Cold Spring Harbor (*1*), it is important that genes and gene products be given separate symbols. A belated and much needed attempt to systematize blood-group notation along these lines has recently been made (*2*). A great deal of information on the biochemistry and genetics of abnormal human hemoglobins is now available. The nomeclature of the hemoglobin types was standardized at a meeting held in January 1953 by the Hematology Study Section of the Division of Research Grants of the National Institutes of Health, Bethesda, Maryland (*3*).

It was proposed that fetal hemoglobin should be referred to as type F, normal adult hemoglobin as type A, and sickle cell hemoglobin as type S. Two other variants were termed type C and type D. Another genetically determined abnormality of hemoglobin previously described by Hörlein and Weber (*4*) was overlooked. The defective globin formed in this disease is responsible for a distinctive variety of methemoglobinemia, and this hemoglobin can conveniently be termed type M(*5*). Since 1953 descriptions of six other hemoglobin types—E(*6*), G(*7*), H(*8*), I(*9*), J(*10*), and K(*11*)—have been published.

I have recently obtained evidence, a detailed report of which is in preparation, that the hemoglobin in the primitive generation of red blood cells in early fetal life is different from the fetal and adult hemoglobin types. This third normal hemoglobin will be termed primitive-type P. It seems that the processes leading to the formation of the three normal hemoglobin types (P, F, and A) are under independent genetic control. In the mouse, there is a gene *f* which, when present in double dose, severely retards the synthesis of fetal hemoglobin but has no influence on the synthesis of primitive and adult hemoglobins. In this way, a severe hypochromic anemia is produced in late fetal life which spontaneously recovers after birth (*12*). The thalassemia gene in human beings has the converse effect: It retards synthesis of adult hemoglobin, but seems to have no effect on fetal hemoglobin synthesis (*13*). The various genes that are responsible for the formation of abnormal human hemoglobins, such as the sickle cell gene, also have no detectable influence on fetal hemoglobin formation.

The relationship of the genes affecting hemoglobin synthesis in human beings is not completely clear, but some generalizations can be made. The formation of hemoglobin types S, C, and G is controlled by genes that appear to be allelomorphs of a gene controlling one stage of adult hemoglobin formation (*14*), and the same may prove to be true of the genes controlling formation of hemoglobins D, H, I, J, and K. There is some evidence, however, that the thalassemia gene is not an allelomorph of the other genes affecting hemoglobin formation (*10, 11*).

No uniform or widely accepted notation for these genes is available. Usually the same symbol is used indiscriminately for a gene and for the hemoglobin type that is produced in its presence. Neel has used the symbol *Sk* for the sickle cell gene and *sk* for the normal allele (*15*) and Th^i and *Th* for the thalassemia gene and its normal allele, respectively (*16*). Silvestroni and others (*17*) have used the symbols *M* (for microcythemia) and *m*. These symbols, which imply that the sickle cell and thalassemia genes are dominant to the normal alleles, fail to draw attention to one of the most remarkable features of the abnormal hemoglobin genes: The occurrence of contrasting allelomorphs, each of which has dominant effects. In all the cases analyzed so far, heterozygotes are distinguishable from homozygotes by biochemical and other tests.

A new notation for the genes that is uniform and in accordance with that adopted elsewhere in genetics is therefore proposed. Genes should be consistently placed in italics and letters for the hemoglobin types themselves should not be italicized. Each locus should be indicated by a single capital letter or a capital and a small letter, and the allelomorph should be indicated by an appropriate suffix attached to the locus symbol. A capital in the suffix is dominant to a small letter in the suffix. When allelomorphs, each with a capital in the suffix, are brought together they both exercise their effects. Thus, a capital in the suffix represents a gene that exercises its effect whenever present, the effect of one dose not necessarily being the same as that of two doses.

In this case, the locus for the gene controlling normal adult hemoglobin synthesis, which is allelomorphic to the genes controlling the formation of sickle cell hemoglobin, and so forth, should be termed *Hb* (for hemoglobin). The normal allelomorph is then indicated by the suffix A, the sickle cell allelomorph by the suffix S, and the allelomorphs controlling the formation of hemoglobin types C, D, and G by the suffixes C, D, and G, respectively. Thus, the normal individual is of genotype Hb^A/Hb^A, the carrier of the sickle cell trait is of genotype Hb^A/Hb^S, and the patient with homozygous sickle cell anemia is of genotype Hb^S/Hb^S; those with sickle cell:hemoglobin-C disease are of genotype Hb^S/Hb^C, and correspondingly for other genotypes and phenotypes.

Since the thalassemia locus appears to be different from the sickle cell locus, it is indicated by a different symbol, *Th*. The normal allelomorph is indicated by the suffix N, and the thalassemia allelomorph by the suffix T. Thus, the normal individual is of genotype Hb^A/Hb^A; Th^N/Th^N, the heterozygote for thalassemia is of genotype Hb^A/Hb^A; Th^N/Th^T, and the patient with sickle cell:thalassemia [who is heterozygous for both the sickle cell and the thalassemia gene (*10*)] is of genotype Hb^A/Hb^S: Th^N/Th^T. The locus for Hörlein and Weber's methemoglobinemia is unknown.

If any allelic gene controlling hemoglobin formation is discovered that is not recognizable at all in the heterozygous condition, the corresponding suffix should be a small letter. Genes affecting primitive or fetal hemoglobin would not be placed at loci *Hb* or *Th* (*19*).

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3 June 1955

Natural Redistributon of a Quahog Population

It has been characteristic of intertidal quahog (*Venus mercenaria*) sets in Maine that they are of commercial importance only at infrequent intervals and that survivors that reach market size are generally poorly distributed over the available flats. Approximately 95 percent of the fishery is intertidal, and whenever there are sets of commercial importance —as there were in 1938, 1939, 1947, and 1952—they usually occur in limited areas and in very dense concentrations. Although mortality rates are high and invariably exceed 90 percent by the end of the second season, it has been assumed by shellfish biologists working in Maine that the concentrations—sometimes as high as 25,000 quahogs per square foot—take place shortly after setting, probably as the result of involuntary redistribution (*1*).

The actual process of redistribution has not been observed, nor, heretofore, has its extent been measured. Since concentrations made up of individuals as small, on the average, as 3 mm in diameter have been observed, it has also been assumed that redistribution takes place only among the smaller sizes and does not occur on an involuntary basis among adults.

In November 1949 the residue of two widely separated concentrations from the 1947 year-class was discovered in Maquoit Bay, Maine. Because it has been customary during the past decade to transplant overcrowded quahogs to adjacent barren flats to resupply the commercial fishery, salvage operations were carried on from May to December 1950, using quahogs from the more unfavorably located of these two concentrations.

Similar operations for the other area had to be postponed until the spring of 1951. It was decided, in the meantime, to use this remaining concentration as a study area, to survey its geographic limits, to estimate its population and the volume of that population, to measure winter survival, and to make other related observations and determinations during the cold-weather period.

A plane table survey using a telescopic alidade was made during daylight low-water on 17 and 18 Oct. 1950. A flat ledge outcrop within the concentration served as an excellent station for setting up the instrument. The purpose of using a plane table (*2*) for the survey was to insure a high order of accuracy in determining the limits of the occupied area (a reconnaissance of this concentration had indicated that it was surrounded by barren flats several hundred feet in width) and to locate as accurately as possible the sample plots that had been selected for measurement of density and size distribution.

Horizontal stadia to 11 critical points on the perimeter of the concentration were measured. These points were selected wherever a marked change in direction occurred. The remainder of the perimeter was interpolated between these established points. Within the perimeter, 35 sampling stations were surveyed and plotted. The lateral error did not exceed 0.1 ft, and it was estimated that horizontal error, since the longest stadia measurement was only 478 ft, did not exceed 1.0 ft. The population density of the concentration averaged 79.5 per square foot, with a size range from 27 to 56 mm and a median diameter of 43 mm. After the survey had been completed, the area of the concentration was determined by planimeter to be 3.28 acres, more or less.

The concentration remained under periodic observation during the winter and, following the discovery of mass mortalities that took place between 24 Dec. 1950 and 4 Feb. 1951—apparently as the result of gales that removed the sediment (*3*) cover and that were followed by alternate freezing and thawing air temperatures, during low-tide periods—a resurvey to assess the damage was made (*4*). Reconnaissance of the concentration before resurvey indicated considerable displacement and dispersal of the population during the winter. This observation was confirmed by the resurvey made on 29 Mar. and 20 Apr. 1951 in which the procedure of the initial survey was duplicated, except that the sampling fraction was increased from 1/4080 to 1/2895 for greater accuracy.

The redistribution of the population, in general, followed the expected pattern. The storms that had the highest wind velocities, one of a recorded 76 mi/hr, were from the southeast, and the greatest displacement was toward the northwest for a maximum distance of 387 feet, although some redistribution had taken place all around the old perimeter of the concentration, except at the southwestern end. In a small tip at the southwestern end, which had previously had an average density of 23 per square foot, the quahogs had been completely displaced. On the other hand, one previously barren area, the center of which was 182 ft northwest of the old perimeter, had acquired a living population density of 36 per square foot.

The plane table and alidade provided precise means for defining the limits of the geographic redistribution, and sampling within the area supplied detailed information on the extent of this redistribution. Since all sample plots had been surveyed, it was possible to compare changes in population density within a relatively small subarea before and after redistribution.

One 10,300-ft² subarea with its long axis running north and south had in October contained an average population of 116 per square foot, but by spring it had been further subdivided into smaller subareas having average densities from north to south of 19, 40, 21, and 40 per square foot.

The most densely occupied portion of the concentration in October had been one of 38,800 ft² that contained an average population of 125 per square foot. By the time of the resurvey, this average had been reduced to 40 per square foot, and in some sections to concentrations as low as 23 per square foot. Even the most densely populated section, one of less than 1000 ft², had a population of only 63 per square foot.

Several small colony-like concentrations of 30, 36, and 65 per square foot were discovered during the resurvey northwest of the old perimeter in flats that had been barren the preceding October. These colonies occupied areas from slightly more than 2000 ft² to nearly 17,000 ft².

Although the concentration at the time of the initial survey occupied an area of 3.28 acres, more or less, the surviving redistributed population, which had been reduced 40.3 percent by winter mortalities, occupied an area of 6.81 acres, more or less, and the physical center of the redistributed population had been displaced northwesterly an average distance of 100 ft. While the resurvey accounted for all animals, living and dead, that had occupied the area at the time of the initial survey, the density per square foot of 79.5 in October had been changed to an average combined living and dead density of 41.7 by the time of the resurvey.

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9 June 1955

Reaction Rates of a Muscle Model with Nucleotides

We have previously reported (*1*) that UTP (uridine triphosphate) might replace ATP (adenosine triphosphate), mole for mole, in eliciting the contractile response that is characteristic of the glycerol-extracted muscle fiber model. The present report (*2*) is an extension of this work to include an analysis of the rates of response of the model to ATP, UTP, and CTP (cytidine triphosphate). In addition, some indirect evidence is exhibited to support the hypothesis that the reaction of these nucleotides with the contractile protein may be a direct one that need not be mediated by a high-energy phosphate group transfer system such as the nucleoside diphosphokinase system identified by Krebs and Hems (*3*) and recently purified by Berg and Joklik (*4*).

The methods were essentially the same as those used in earlier experiments (*5*). Dog or rabbit psoas muscle fiber bundles were extracted at rest length in 2.9*M* glycerol at −15°C. A fiber bundle of about 0.1-mm² cross-sectional area was isolated and divided to provide a pair of shorter duplicate preparations, one of which was induced to contract with ATP, and the other of which was contracted in the presence of either CTP or UTP (*6*). The medium in which contraction was induced was phosphate-buffered $5 \times 10^{-2}M$ KCl containing $5 \times 10^{-3}M$ $MgCl_2$, at *p*H 7.8 and ionic strength 0.11 at 25°C. Nucleotides, as sodium salts, were added to the system to make their concentrations 4, 6, or $8 \times 10^{-4}M$. The latter value approximates the minimum amount of nucleotide necessary to induce maximal contraction (*5*). The tension developed by the model in the first minute following nucleotide addition was used as the criterion of the rate of the contractile response.

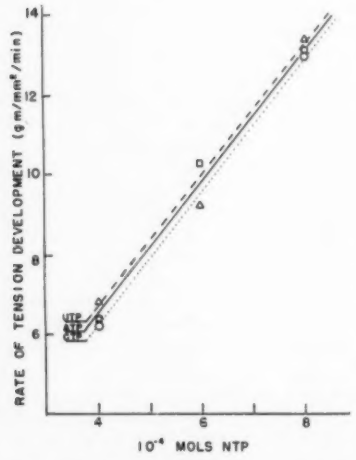

Fig. 1. Rate of tension development of the muscle model system when either ATP, CTP, or UTP was used as the stimulating nucleotide. Each point is the mean response of three or more fiber preparations. ATP, △———△; CTP, ○·····○; UTP, □ - - - - - □. The abbreviation NTP stands for any one of the three nucleotides tested.

The rates of tension development in a rabbit psoas model system are shown in Fig. 1. As nucleotide concentrations were increased toward the value necessary for maximal contraction, the rate of contraction increased linearly. It would appear that there was no significant difference in the model responses to either ATP, CTP, or UTP. Through accident the data for CTP at $6 \times 10^{-4}M$ were useless. Limited amounts of this material prevented complete repetition of the experiment, but a second comparison at this concentration alone showed no significant difference in the rates of tension development when either ATP, CTP, or UTP was used to stimulate contraction of the model system.

It is of interest that preliminary experiments employing guanosine triphosphate or adenosine tetraphosphate (*7*) as the nucleotide in this model system showed greatly reduced rates of tension development when they were compared with ATP-stimulated responses. Confirmation of these observations would indicate that a certain degree of specificity exists in the nucleotide-actomyosin reaction that might be related to nucleotide structure.

In order to elucidate further the similarities of the reaction of these nucleotides with the contractile proteins, the rates of tension development were diminished by employing several nonspecific inhibitors of the contractile response. Table 1 shows the similarity in degree of inhibition of the ATP or UTP response achieved by (i) aging the fibers 21 days at −15°C; (ii) partial sulfhydryl-group blockade with *p*-chloromercuribenzoate; and (iii) two intensities of trypsin digestion. These data have been interpreted as indicating that even when some essential sulfhydryl groups were blocked or when partial denaturation was achieved either by aging or by digestion, no significant differentiation in the model response to these two nucleotides was effected.

In certain energy-transfer systems (*4*), only one of the purine or pyrimidine nucleotides reacts directly with its acceptor substance. We must conclude from the present evidence, however, that for the muscle model system utilized in this investigation, three constituents of the "nucleotide pool," ATP, CTP, and UTP, may be equally available for direct and independent reaction with actomyosin to effect the molecular rearrangement that is the essence of muscular contraction.

Table 1. Nonspecific inhibition of the model response to ATP or UTP addition. (Dog psoas fibers extracted for 7 days were treated with each inhibitor and the rates of contraction of duplicate fibers were measured when either $10^{-3}M$ ATP or $10^{-3}M$ UTP was used to stimulate tension development)

Treatment	Percentage inhibition	
	ATP	UTP
Fibers aged 21 days at −15°C	58	62
p-Chloromercuribenzoate ($10^{-4}M$)	46	59
Tryptic digestion (trypsin concentrate, 2μg/ml, 5 min at 25°C)	34	50
Tryptic digestion (trypsin concentrate, 2μg/ml, 10 min at 25°C)	73	72

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7 June 1955

North-South Asymmetry of the Pleistocene Ice Sheet

Geologists have long considered the great continental ice sheets of Pleistocene time to have been more or less symmetrical. An examination of the meteorology involved, however, does not lead to such a conclusion.

The cold winds that sweep across the Northern Hemisphere land masses may be described as polar air moving south-

ward. The cold air that chills the United States between October and April acquires its chief characteristics in Canada, Alaska, the northern Pacific, or, less commonly, in the northern Atlantic or in the northern mountain states. Such winds are called "northers" in many parts of the country because of the obvious source. The moisture that accompanies such winds is not, however, derived from the same source.

An outbreak, to the south, of polar air is generally accompanied by a southward displacement of the polar front, a more-or-less continuous east-and-west boundary zone between colder air to the north and warmer air to the south. In the winter, the polar front commonly lies across the United States. On the polar front are developed local eddies (these are 300 miles across, more or less). In each eddy, the polar front may be bent northward toward an apex at the center of the eddy. The left, or west, limb is a cold front, and the right, or east, limb is a warm front. (Mirror image relationships exist between the Northern and Southern Hemispheres.)

The cold air mass, the polar front, and hence the cold and warm fronts move southward, generally from Canada. The precipitation that accompanies the cold and warm fronts, however, is derived from the south. Warm, moist Gulf of Mexico or Atlantic air, lifted by the outbreaking polar air mass, is forced 20,000 feet or more above the ground surface; in the ascent it loses part of its moisture. The cold air, then, moves from the north, but the moisture has its source to the south. The material reviewed in the preceding paragraphs can be confirmed in almost any introductory textbook on meteorology.

It should be reasonably obvious that an outbreak of polar air is not necessary to precipitation of moisture from Gulf or Atlantic air. Should saturated tropical maritime air flow northward across the continent, topographic irregularities would result in a lift similar to that associated with the cold and warm fronts. Such "orographic" rain is in part responsible for the excess precipitation that coastal-plain and foothills areas receive over midwestern states. Under otherwise constant conditions, rainfall is a function of altitude. Nor should it matter a great deal whether the topographic irregularities are composed of rocks or ice.

Many North American geologists have presented the idea that the ice sheet was about 2 miles thick (*1*). Revelle, Sverdrup, and Munk (*2*) have recently suggested that either heat flow from the rocks beneath or plastic flow within the icecap will impose a thickness limit of between 1 and 6 kilometers. If their calculations are accepted, and isotasy is considered, the ice sheet may be treated as an orographic barrier that grew to heights between 5000 and 15,000 feet above undisturbed ground level. Such an orographic barrier, extending in an east-west line across the northern tier of states (or southern Canada), would be nourished by moisture derived from the south and, to a lesser extent, from the east. The northern and northwestern slopes would receive much less precipitation.

The Himalaya Mountains constitute an east-west orographic barrier with a regional altitude at least as great as that given in the preceding paragraph. North of the mountains, annual precipitation is in general less than 25 centimeters, and at all points it is less than 50 centimeters. South of the mountains, annual precipitation falls between a low of 100 centimeters over most of the plain of the Ganges River and a high in excess of 200 centimeters in the foothills and along the southern mountain slopes.

From this description, it may be reasoned that an ice sheet, initiated southeast or south of Hudson Bay, should grow southeastward or southward. Further, the higher it grows, the faster it should grow, until it reaches certain natural limits, such as those suggested by Revelle, Sverdrup, and Munk (*2*), or that imposed by the warmer air to the south. At the time of maximum development, such an ice sheet should have, in a north-south line, an asymmetrical profile, with the steepest slope at the south end of the line, and with most of the profile appearing as a gentle northward slope, tapering off in northern Canada. The southern slope would be of the order of 1 degree.

Further, except for early growth, such an ice sheet should be actively moving only in the zone of the steep southern slope; it should be essentially stagnant in the zone of the gentle northern slope. Such an ice sheet should have, at the time of maximum development, its greatest thickness (and hence the area of greatest scour, deepest depression, and highest rebound) near the southern limits.

A south-facing topographic barrier should have a strong effect on the behavior of the jet stream. Studies in the Himalaya Mountain area (*3*) show that the jet stream passes north of the mountains during summer and south of the mountains during winter. Perhaps an ice barrier such as I have described would not be passed on the northern side; if it were, the jet stream would have no suitable source of moisture with which to nourish the northern slope.

The jet stream is associated with two zones of air, one to the north and the other to the south. At 5000 to 10,000 feet, the northern zone is much the colder, with a temperature differential of the order of tens of degrees Celsius (*4*). Localization of the jet stream south of an ice barrier might serve to stabilize, geographically, this northward temperature gradient and, thereby, help to preserve the ice sheet.

If this is correct, the jet stream would aid in the development of the asymmetrical north-south profile of the ice sheet, and it would be indirectly responsible for the concentration of glacial scour near the periphery of the ice.

An asymmetrical ice sheet with the maximum bulk of the ice centered in the Great Lakes area leads to certain conclusions regarding isostatic loading and rebound, tilting, and the distribution of various ice-formed geomorphic features.

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3 June 1955

Stilbestrol-Contaminated Feed and Reproductive Disturbances in Mice

Serious reproductive disturbances, including scrotal hernia and persistent estrus, have been encountered in the breeding colony of white Swiss mice at the Rocky Mountain Laboratory as a result of inadvertent contamination of pelleted feed with diethylstilbestrol (stilbestrol) during processing in a mill previously used to prepare cattle supplement that contained the drug. Persons in charge of breeding colonies of mice and other small laboratory animals, as well as individuals using these animals for certain endocrinological studies (bioassay for estrogenic activity, pregnancy tests, hormone research), should be alerted to this potential hazard. Although a detailed account of our experience is in preparation, we should like to recount the highlights for the immediate benefit of others who may be confronted with the problem.

The mouse feed used at this institution is prepared according to our formula by a local feed mill. It is delivered in 3000-lb lots at 7 to 10 day intervals. Four separate lots of the pellets were shown to have appreciable estrogenic activity by bioassay (*1*) in 7 to 9-g female mice. None of the basic ingredients (soybean meal, corn, alfalfa meal, and meat and bone scrap) that had been used in preparing these lots of pellets showed such activity when they were similarly tested.

At the time of the disturbance in the mouse colony, the manufacturer of the pellets had not yet begun regular production of cattle supplements containing stilbestrol. However, it was learned that at least one batch of such feed had been prepared at the request of a local veterinarian and that the same mixing equipment had been used to process both the cattle feed and the mouse pellets. As far as we could determine, the cattle supplement had been processed at about the time of preparation of the first lot of pellets that showed estrogenic activity. The processing equipment presumably contained residual drug for some time afterward, since several subsequent lots of mouse feed also had demonstrable estrogenic activity.

In view of our findings, the use of common processing equipment for the preparation of feeds for laboratory animals and livestock supplements containing stilbestrol would seem to represent a serious potential hazard. All groups concerned—feed manufacturers, breeders of laboratory animals, and the laboratory worker—should be cognizant of the problem, since undoubtedly our experience is not unique.

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Note

1. Roy Hertz, National Cancer Institute, National Institutes of Health, kindly performed the bioassays for estrogenic activity.

5 August 1955

Factors Influencing Curvature in the Avena Test for Plant Hormones

In the present study, attempts have been made to determine factors influencing the response of *Avena* coleoptiles to a given concentration of indole-3-acetic acid (IAA) (*1*). The standard *Avena* test method as described by Went (*2*) was used, but with variations as noted. Standard IAA solutions ranged from 15 to 160 μg/lit.

Preillumination by varying exposures to red light, or complete absence of light, during the 3 days of growth prior to testing did not consistently increase or decrease curvature. Red light is customarily used during this period to prevent elongation of the first internode; this facilitates pulling the primary leaf in the second decapitation but produces no effect on curvature.

Table 1. Effect of time interval between the second decapitation and the application of agar blocks. Each figure for curvature represents the average of six plants in response to the indicated IAA level

Time lapse (min)	Curvature (deg) at IAA levels			
	20 μg/lit	40 μg/lit	80 μg/lit	160 μg/lit
5	21.6	33.1	45.5	43.0
15	16.9	27.6	39.0	37.0
30	18.0	24.0	30.3	27.1
60	16.1	19.0	26.1	25.0

High temperatures, often thought to decrease the *Avena* response, had no noticeable effect. Even at 31 to 32°C, excellent curvatures were obtained.

Subsequently, a marked increase in curvature was found when the interval between the second decapitation and application of agar blocks was held to a minimum. The effect of this time lag is shown in Table 1. This effect was demonstrated repeatedly and without fail. The previous practice in this laboratory had been to decapitate the entire series of test seedlings, that is, 10 rows of 12 plants each, and then to apply the agar blocks, imposing a ½- to 1-hour delay between the operations. The present practice is to apply the agar blocks after each row is decapitated. By this method, a single plant may have a curvature of more than 50 deg in response to 100 μg/lit of IAA. By the previous method, about 30 deg was considered the maximum response.

The time lapse between the first and second decapitation had a minor effect on the curvature response. Table 2 indicates that the longer interval between decapitations is preferable.

Reexamination of data presented by Goodwin (*3*) using the soil culture *Avena* technique and by Schneider and Went (*4*) in recommending a second decapitation points to increased sensitivity in agreement with these findings.

The results of the present investigation suggest that auxin regeneration within the coleoptile tip may be responsible for the striking differences in curvature response. The longer interval between the first and second decapitation would diminish auxin regeneration after the second decapitation. The immediate application of agar blocks would permit the maximum effect of unilateral application of IAA before auxin is uniformly regenerated throughout the coleoptile tip.

Table 2. Effect of time interval between the first and second decapitation. Each figure for curvature represents the average of 8 to 12 plants. Agar blocks applied 10 to 15 minutes after second decapitation, that is, every two rows

Time lapse (hr)	Curvature (deg) at IAA levels			
	15 μg/lit	25 μg/lit	50 μg/lit	100 μg/lit
1	11.4	18.1	26.3	36.4
3*	16.4	22.6	31.9	44.7
4	15.9	29.8	38.3	46.0

* Standard interval.

Supporting evidence is found in the high curvatures reported by Skoog (*5*) in the deseeded *Avena* method in which removal of the seed prevents regeneration.

If rapid regeneration of auxin is the case, it might in turn be influenced by preillumination or high temperatures, making the immediate application of agar blocks more or less critical.

Recent reports in the literature indicate that investigators often rely on small differences between average curvatures of less than 10 deg. Increasing the sensitivity of the *Avena* plants by the immediate application of agar blocks will increase the reliability of results as well as eliminate some of the variability found between laboratories.

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8 June 1955

Influence of Thyroxin and Thyroglobulin on Rice Moth Larva

The influence of thyroxin and other thyroidal preparations in different insects has been studied from time to time by various workers (*1*); and, as has been assumed by Goldsmith (*2*), much of the experimental work carried out so far in this field is open to criticism in that dosages were not adequately controlled (possible improvement of the ration by the thyroid supplement or possible toxicity of higher concentrations), and the insects were not of known ancestry. Further, there was no uniformity in the thyroidal preparations used; many used thyroid extracts, some used hydrolyzed thyroids, while a few others used thyroid substance itself from various mammals. It was therefore considered worth while to reinvestigate this subject by using thyroidal preparations of known potency and the larva of an insect that can be easily grown and a pure strain maintained under standard laboratory conditions.

In our investigation the influence of various doses of pure crystalline thyroxin (as sodium salt) and cattle thyroglobulin (prepared by the method of Roche *et al.*, *3*) on the growth of rice moth larvae (*Corcyra cephalonica St.*) was studied. In each set of experiments, 15 petri dishes (14 cm in diameter) containing 10 g of white wheat flour and different concentrations of thyroxin or thyroglobulin, as detailed in Table 1, were seeded with 5 mg of fresh eggs of the moth collected during the previous 24 hours. At the end of 15 days, two batches of 10 larvae were picked up from each dish and weighed separately, and the average weight of the larvae in each dish was obtained. The average values of three such sets are given in Table 1.

It will be seen from these results that thyroxin up to a dose of 0.75 μg/g of diet has a definite growth-promoting effect on the larvae, while higher doses bring about inhibition of growth and even death at a concentration of 20 μg/g of diet. Thyroglobulin in all the concentrations used failed to show any influence on the growth of the larvae.

The results of oxygen-consumption studies with the larvae fed on different doses of thyroxin or thyroglobulin for a period of 15 days are given in Fig. 1. These results show that thyroxin feeding increases the oxygen requirement, whereas thyroglobulin was not quite effective. The slight increase in the oxygen consumption in the thyroglobulin-fed group over those of the control group can be attributed to the addition to the ration

Table 1. Influence of thyroxin and thyroglobulin on rice moth larvae at the end of 15 days' growth

Dish No.	Thyroxin content in diet (μg/g)	Thyroglobulin expressed as its thyroxin equivalent (μg thyroxin/g diet)	Avg. wt. of larvae (mg)
1			3.05
	Thyroxin-fed group		
2	0.10		3.03
3	0.20		5.36
4	0.30		6.91
5	0.40		7.39
6	0.50		9.29
7	0.75		9.59
8	1.00		6.91
9	2.00		5.96
10	20.00		2.45
	Thyroglobulin-fed group		
11		0.058	3.00
12		0.145	2.98
13		0.290	3.02
14		1.450	3.00
15		2.900	3.04

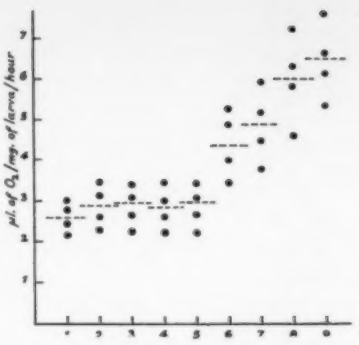

Fig. 1. Influence of thyroxin and thyroglobulin feeding on the oxygen consumption of rice moth larva. (1) Control group (10 g wheat flour); (2) wheat flour (9.5 g) + casein (500 mg); (3) wheat flour (9 g) + casein (1 g); (4) wheat flour (9.5 g) + thyroglobulin (equivalent to 0.29 μg of thyroxin per gram of diet); (5) wheat flour (9 g) + thyroglobulin (equivalent to 0.58 μg of thyroxin per gram of diet); (6) wheat flour (10 g) + 1 μg of thyroxin; (7) wheat flour (10 g) + 3 μg of thyroxin; (8) wheat flour (10 g) + 6 μg of thyroxin; (9) wheat flour (10 g) + 10 μg of thyroxin.

of the animal protein, because a similar slight increase was noticed with the casein-fed group also (Nos. 2 and 3 in Fig. 1). These results show that the larvae, although they do not normally require thyroxin for their growth and maintenance, are still able to utilize thyroxin for their metabolic activity and are unable to use thyroglobulin as a source of thyroxin. This is probably due to their inability to split the protein completely. The influence on the growth would have depended on the amount of free thyroxin present in the various thyroid preparations used by different workers, and this may account for the peculiar results obtained by earlier workers.

These studies show, in addition, that rice moth larva (*Corcyra cephalonica St.*) can serve as a suitable organism for the study of thyroxin metabolism. Studies of the influence of triiodothyronine and other related investigations on this organism are in progress.

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24 May 1955

University Chemistry Teachers

The following survey of the characteristics of university chemistry teachers was made from the data in the American Chemical Society publication *Faculties, Publications and Doctoral Theses in Chemistry and Chemical Engineering (1953)*, supplemented by information from the 1954 edition of *American Men of Science*.

According to the report, there are 89 departments of chemistry offering both bachelor's and doctor's degrees; the 89 departments employ 1465 professorial employees. Of this group 35 percent claim to be physical chemists (including chemical physicists and nuclear chemists), 29 percent are organic chemists, 12 percent are inorganic chemists, 11 percent are analytic chemists, 8 percent are biochemists, and the remaining 5 percent are not classified. Where more than one specialty was indicated, only the first mentioned was counted.

A high concentration of physical chemists at Princeton, Yale, Cornell, Columbia, Chicago, California (Berkeley), and the Massachusetts and California Institutes of Technology was noted, 48 percent of their faculties being so classified, with only 25 percent listed as organic chemists. The schools of the Big Ten (Illinois, Michigan, Minnesota, Wisconsin, Northwestern, Purdue, Indiana, Ohio State, Iowa, and Michigan State) had 31 percent in each of these two major specialties.

The universities from which the faculty members received their own doctorates were few. A total of 34 percent held a Ph.D. degree from Princeton, Harvard, Yale, Columbia, Cornell, Chicago, California (Berkeley), M.I.T. or Caltech, while another 28 percent came from the Big Ten schools. Only 50 persons in the group received a foreign doctorate. It is interesting that 18 of the 19 schools listed in this paragraph obtained 84 percent of their own faculties from within this select group of universities. (Harvard did not provide data for its faculty.)

Regional and environmental preferences are important in a teacher's location. Thus, 48 percent of Big Ten faculty members have a Ph.D. degree from a Big Ten school; 52 percent of the faculties of Princeton, Yale, Cornell, Columbia, and M.I.T. have degrees from these institutions or Harvard; and 63 percent of the California, Caltech, and Chicago faculties have the Ph.D. degree from one of the three. Less than 15 percent of the faculties of the other 71 universities in the report have the Ph.D. degree from the same school at which they work.

The age distribution of the group was as follows: 73 were born before

1890, 228 from 1890 to 1899, 273 from 1900 to 1909, 457 (31 percent) from 1910 to 1919, and 418 (29 percent) from 1920 to 1929. Some declined to list a birth date.

Only 153 are not listed in *American Men of Science* (Physical Sciences volume). Of those who are married (at least 77 percent), 46 percent married between ages 25 and 29, inclusive, and 28 percent between 20 and 24. Only two persons were married before the age of 20, and only 20 listed more than one marriage. The total number of children is 2100, an average of 1.9 per faculty marriage.

Approximately 20 percent reported full-time industrial employment as part of their experience. However, for the purposes of this survey, employment by government agencies, as well as wartime work at Oak Ridge and similar installations, was not counted as industrial experience.

One may reasonably conclude from the foregoing data that university chemists are social and occupational conservatives.

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19 July 1955

Hazards of Biological-Social Analogy

I suppose that H. W. Stunkard may have been teasing, or at least writing with his tongue in cheek, when he contributed "Freedom, bondage, and the welfare state" [*Science* **121**, 811 (1955)]. I can hardly believe that he intends to argue that, at present, we live in the most perfect of all imaginable human societies, and that any further cooperative action to assist our fellow-citizens must necessarily lead us downhill to biological degeneration. I hope that Stunkard will agree that much of the social progress that is now generally accepted as beneficial (universal suffrage, child labor laws, and so forth) was once considered very controversial and dangerous, if not actually contrary to nature.

Of course, Stunkard has the right to hold fast to his own opinions regarding the value of various forms of animal life, even when these opinions appear to have originated from his reaction to situations in human society. However, it is possible to come close to logical sophistry in this way.

To take just one example, it seems a shame to have Stunkard declare that the honeybee is *in reality* ". . . a most pathetic little creature . . . a martyr, and [a] victim of the 'welfare state'." As a person who has had some slight contact with bees, I would like to offer the dissenting opinion that the bee's world appears to be very full, satisfying, and creative, at least from the point of view of the bees. They certainly resent interference. The moral is this: If I hope to establish any sort of meaningful relationship with the bees (and occasionally share in their honey), I must, in some degree, be willing to accept the bees as they are and to cooperate with them in their own way of life. Would it be more patriotic for me to boycott the bees until they agree to accept the principle of universal suffrage and to choose their queen every 4 years in a general election?

I sincerely hope that Stunkard's paper will not be used to give quasi-philosophic support to an idea that has already become one of the chief plagues of our times. This is the idea that we cannot live securely in our American society until we have managed to recreate the entire world in our own image.

In conclusion, I think that we are merely deceiving ourselves, and other people as well, when we take hold of any special political and social philosophies (no matter how worthy), dunk these ideas in the sacred waters of some scientific specialty that has been developed to explain and interpret entirely different phenomena, and then fish them out and bring them back to where they originated in the first place, but now representing them as part of the *cosmic scientific secret of the universe*.

Charles Pentler
Orchard-Laboratory, Cupertino, California

23 June 1955

I cannot agree that Stunkard's conclusions follow from the facts and discussion that he presented. After a considerable array of descriptive information and theoretical deduction about the probable phylogeny of the animal phyla, he stated that "The welfare state offers security to workers on terms of contingent subjection and dependency, but such a social order reduces the individual to abject subservience, and results in the development of a rigid caste system. Dependency and degeneration are cognate phenomena, they go hand in hand. . . ."

Although analogy may be both inspiring and educational, we must recognize the limitations of such illustration. Theory may be contrived, but conclusions, especially those about ethics and morals, should have some relationship to reality. Stunkard's analogy between biological dependency and degeneration on the one hand, and dependency between men, and degeneration of men, in human society on the other, does not warrant the conclusion quoted in the preceding paragraph.

Human beings, by their very nature, must be as dependent as, if not more so than, many other animals, not only in kind but also in degree. Is a dairyman less dependent on his cows than an ant? What organism, other than man, could be more dependent on others for food and survival during childhood and even adolescence? Infants are certainly more helpless than many, if not most, mammals at birth. *Homo sapiens* is even less adequately able organically to synthesize the vitamins necessary for his growth and development than is the lowly bread mold. Have any of these types of dependency any causal relationship with degeneration?

Socially we depend upon one another for the proper maintenance of all aspects of civilization. Industrialization and specialization in research are obvious facets of the interdependence of men. Is an employer less dependent on his workers than the queen bee upon its workers?

Sweden is usually cited as the nation that has developed its consumer cooperative movement more than any other. In my book, cooperation is a form of voluntary dependency, which acknowledges the universal, economic interdependence of men in modern society. "Swedes" have not impressed me as having sunk to "abject subserviency," nor do I recall any slave castes in Sweden.

If degeneracy appears imminent, it may be because of our extravagance with natural resources and because of the days of overpopulation in the foreseeable future. The lack of proper diet that will result can cause the degeneration of coming generations. For biological as well as economic reasons, an atomic war may cause racial degeneration. These are imminent dangers and sources of possible degeneration; compared with them, the likelihood of degeneration owing to a welfare state seems a remote possibility at most.

Leo Francis Koch
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11 July 1955

The thesis that social problems can be solved by applying biological principles can only retard the progress of the social and the psychological sciences. Human societies develop historically, not biologically. Man has changed very little from the biological viewpoint in many thousands of years, and yet he has lived in a series of very different societies that have evolved one from the other as his productivity has grown. Along with changes in his social organization go changes in his ideas resulting from, and also contributing to, the changes in society. Biol-

ogy alone gives us no understanding of the different forms of society, the varying content of ideation, or the resulting problems. The principles governing the behavior of the language-using, concept-forming human species include biological principles but are by no means limited to them.

E. FREUNDLICH
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27 June 1955

Stunkard alludes to the "welfare state" in very broad and damaging statements. In contrast to the closely knit and well-defined biological descriptions, he not once in the article gives one definition, one economic, or sociological description of this "welfare state." I would think that if one wishes to make an analogy between two things, one would define and describe these two things in as definitive a way as one's knowledge enables him to do.

PHILIP SIEKEVITZ
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5 July 1955

I find somewhat disturbing Stunkard's reasoning in his interesting essay. He described the physical changes in the structures of animals that have changed from a free-living to a fixed, communal or parasitic condition. These changes he characterizes as regressions and argues from there that this will be the fate of man if he also should follow the same "slippery path."

This application of a heterogenous collection of zoological facts to human society is clearly indicated by the title. Certainly *freedom, bondage,* and *welfare state* are terms that can be applied to animals only by the broadest poetic license. Initially Stunkard draws a parallel between the free state of an animal in which it independently secures its food and fights in various ways for the privilege of reproduction and the human concept of freedom.

These two concepts however are by no means the same thing. No champion of human freedom ever intended the word *freedom* to mean that man should revert to a savage state. Instead freedom has always meant, in human terms, the right of a man to live and believe as he wishes so long as those wishes do not deprive his neighbor of his inherent freedom—in other words, not only respect for his own rights, but a deep and equally binding respect for the dignity of others. This is our classical concept of freedom, and cannot be applied to the hunting and reproductive habits of wild animals.

Stunkard furthermore implies that certain anatomic changes resulting from adaptation to a static living habit are symptoms of "degradation" of the animal. Is it Stunkard's opinion that the species of Gephyrea he mentions are any the less happy and contented because metamerism is lost? that *Echiuris* leads an unfulfilled existence because in the adult several pairs of mesoblastic somites are lost? that the flatworms mourn forever the loss of their cilia? or that fleas and lice are degraded and shamed by the absence of wings?

The obvious fault in this reasoning is that Stunkard uses the word *regression* not only in a scientific sense, meaning a return down the evolutionary path, but also in a moral and human sense, meaning falling into evil or shameful ways. Regression in evolutionary terms cannot be judged morally, since moral issues are not involved. It can be regarded only as successful or unsuccessful.

Freedom is a product of our human society, as is bondage and the welfare state. The sources and structure of freedom will not be found in an investigation of the sexual or feeding habits of the annelids. Nor can a "welfare state" be even slightly understood by studying the bee.

R. R. MERLISS
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22 June 1955

On Brain to Body Ratios and the Evolution of Intelligence

In his paper on the brain to body weight ratios of mammals [*Science* **121**, 447 (1955)], H. J. Jerison uses the data from my monograph [*Ann. N.Y. Acad. Sci.* **46**, 933 (1947)] as the basis of his discussion, but he develops his theme solely, I believe, out of the well-known Dubois formula, $E = kP^{\beta}$ (obviously identical with the Huxleyan "allometric" formula, $y = ax^{\beta}$). He concludes: "Deviation from the expected brain weight in the primates can be accounted for by assuming a special evolution of the brain in the direction of the development of additional cerebral tissue, the weight of which is independent of the body weight."

There is not space to document the fact that others besides myself have found the Dubois formula shaky ground. I do not believe that anyone today would advance it on such slim technical premises as Dubois did. Let me simply point out that (i) over decades quite a few investigators have accepted the formula without critical examination and have developed consequences from it that are no safer than their foundation; (ii) the formula simply fails to fit more than a small middle range of mammalian data, leaving data beyond either end—extensive arrays—uncovered. (This is obvious even to the eye in Jerison's adaptation of my figure.) (iii) Whatever the shortcomings of my monograph are (and it has them), it finds that all extant mammalian data—including data on primates and man himself—can be subsumed under one common mathematical formula or pattern. In other words—any notion that man is aberrant among mammals simply disappears—insofar as my formulation has any validity.

I believe that the principle of Occam's razor demands that we first explore for mathematical formulations that do not require such speculative bolsterings as that just quoted. And apart from logical economy, the notion that primates peculiarly develop "additional cerebral tissue, the weight of which is independent of the body weight," seems to me an unseizable form of theoretical biology.

EARL W. COUNT
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12 May 1955

E. W. Count's criticisms should be understood in terms of the basic aims of my paper. I was most concerned with developing an anatomical measure that could serve as an independent criterion for comparing species in terms of intelligence, and I sought to develop the measure from simple assumptions about the evolution of the brain. The relationship between brain weight and body weight was chosen, not because it is necessarily fundamental, but because the "index of cephalization" developed from this relationship had been the only measure at all related to our guesses about the relative intelligence of contemporary mammals (*1*). As I have shown in my paper (*2*), inconsistencies in that index limit its usefulness, and a reanalysis of the problem was necessary.

In attempting this reanalysis I accepted as a first premise that, regardless of intelligence level, a larger body would necessarily require a larger brain, because more tissue would have to be controlled. The problem was then to decide on a function relating brain weight to body weight. One of Count's main criticisms is of my choice of the "allometric size function" for this relationship. He would have preferred, I assume, that his function

$$\log E = k_1 + k_2 \log P - k_3 (\log P)^2$$

be used (E is brain weight, P, body weight, and k_i, constants). Although I was familiar with Count's equation, I chose to use the simpler and more conventional allometry formula, because, in spite of Count's suggestion that this formula does not fit the data adequately, a statistical, rather than an intuitive, test of goodness of fit indicates that the allo-

metry formula is acceptable (*3*). Incidentally, it should be noted that the use of the allometry formula does not commit one to Dubois' rationale. As I stated in my paper, ". . . it provides a satisfactory *empirical* description of brain weight and body weight relationships for the mammals as a class."

Count's other criticisms seem to arise from his feeling that his "mathematical formulation" adequately accounts for mammalian data, and that I introduced unnecessary assumptions in my analysis. A brief reply to this point is impossible. I can state, first, that Count's analysis depends on the introduction of a second-order equation in log P and three constants, k_1, k_2, and k_3, without any attempt to justify the form of the equation or to suggest the biological significance of the constants. Occam's razor demands that "entities must not be multiplied beyond necessity" (*4*), and the terms of an equation are entities whether or not they are assigned physical referents. The fact that Count's "mathematical formulation" was not given a biological rationale is not an argument in its favor in terms of criteria of parsimony. A more detailed critique of Count's formulation has been presented by Sholl (*5*).

As for my assumptions and resulting analysis, the allometry formula, although it is presented in my paper as an empirical equation, can, in its general form be derived from simple assumptions. Dubois' error was less in his rationale for using the general equation than in his technique for determining a value for the exponent. A complete presentation of the argument would be out of place here, but Sholl's paper (*5*) covers some of the necessary ground.

My assumption that part of the brain weight is a function of intelligence and is evolved independently of the evolution of body weight is another way of stating the rather common notion that a given level of intelligence for a species is related to a given amount of brain. (I did not raise the problem of individual differences within a species.) At no point did I suggest that the primates are unique in developing this part of the brain weight. I specifically assigned the development to the mammals as a class and used the contemporary opossum as a species that represents the hypothesized primitive mammalian condition in which the entire brain weight is related to the body weight by the allometry formula. One of the advantages of my approach was, in fact, that the resulting equation presents a "common mathematical pattern" for mammals that made sense of primate data. Furthermore, human data were also subsumed under this pattern. And finally, the order of intelligence derived for macaques, baboons, and the orang on the basis of delayed reaction tests (*6*) follows the same order as that derived in my paper. These considerations show, I think, that my biological speculations were adequately seizable.

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19 July 1955

Seasoning for the Calendar

The World Calendar would be assured of adoption if the United States would favor it. The postponement of its approval gives us a chance to include season balance in our new calendar.

Why does the winter solstice occur about 10 days before the end of the calendar year? The early Latins could start each 304-day calendar year with the same annual natural phenomenon, because they did not count winter days. After January and February were added to the old 10-month calendar, the 355-day Numa Calendar rapidly got out of phase with the natural year, because every day was counted. In the time of Julius Caesar it was a quarter of a year ahead. Intending to restore the year's ending to the winter solstice, Caesar added 90 days to 46 B.C., making it a season adjustment year 445 days long, which ran 5 days past the winter solstice. He never got around to correcting the error. In 45 B.C. he established a calendar of 365¼ days. By the 16th century A.D. the Julian Calendar was ending 20 days after the winter solstice, owing to its simple leap-year rule. Pope Gregory took 10 numbers out of October in 1582, making a partial adjustment year of 355 days, leaving 31 December still 10 days past the winter solstice. Gregory's refinement of the leap-year rule causes our present civil year to equal almost exactly the true length of the solar year and immobilizes the year's end at a meaningless time 10 days after the solstice.

If having the new calendar begin the day on or after the meaningful moment of some annual phenomenon would enhance its chances of approval, we should promote the idea. If Caesar and Gregory could declare adjustment years during times when changes were rare, why cannot we, who are experiencing many changes, declare another adjustment year and complete the return of 31 December to the solstice?

While we continue under the Gregorian Calendar with its date numbers progressing through the days of the week, we can choose for season adjustment a year in which a skip of 10 numbers will place 31 December of that same year on a Saturday; 1957 will be such a year; 1963 will be another such year. In 1957 (or 1963) 12 October followed by 23 October will put 31 December on a Saturday. Under the stabilized World Calendar *every* year will begin on a Sunday, and we can never omit 10 numbers without either forcing 1 January away from Sunday or breaking the cycle of the days of the week.

The persons who are the most influential in sponsoring the World Calendar fail to see the difference between absolute time and a man-made instrument for keeping track of time. They ask, "When and where will these lost days be reinstated?" Our reply can be, "When and where did we reinstate the days 'lost' by Gregory?" By deleting 10 calendar numbers during only one specified year, we shall not be deprived of days or bring the solstice any sooner; we shall merely leave out number labels on a time chart and give the calendar a different reading for the day the solstice arrives. If one's income for the 355-day adjustment year will be less, one's grocery bill will be less, also. A bank loan due 15 November 1957 will be due 25 November instead.

In revising our calendar, must we let a 2000-year old error and a 400-year old "fixation" prevent us from matching the calendar quarters with the four seasons? *Before* we adopt a static calendar, let us first synchronize our civil year with the solar year. Worldsday, the intercalated, unnumbered day between calendars, can be Solstice Day to boot. The first day of each quarter can be the first day of a season.

JOHN J. CASE
409 Westwood Avenue, Kingsford, Michigan
1 August 1955

Every great advance in science has issued from a new audacity of imagination.—JOHN DEWEY.

Book Reviews

Analytical Cytology. Methods for studying cellular form and function. Robert C. Mellors, Ed. Blakiston Div., McGraw-Hill, New York–London, 1955. xi + 511 pp. Illus. $15.

Acquaintance with most of the nine topics covered in this textbook is essential to an appreciation of modern cytological research. Subtitled "Newer methods for studying cellular form and function," the subjects under the heading "Optical spectral region" are "Cytophotometry" by A. W. Pollister and L. Ornstein, 67 pages, 127 references; "Histochemical staining" by A. B. Novikoff, 48 pages, 354 references; "Phase-contrast, interference-contrast and polarizing microscopy" by R. Barer, 87 pages, 171 references; "Ultraviolet microspectroscopy" by J. I. Nurnberger, 37 pages, 158 references; and "Fluorescence microscopy" by O. W. Richards, 28 pages, 208 references. Under methods using other forms of radiation are "Electron microscopy" by C. C. Selby, 67 pages, 190 references; "Radioautography" by P. J. Fitzgerald, 43 pages, 89 references; "Historadiography" by A. Engström, 26 pages, 51 references; and "X-ray diffraction" by G. Oster, 20 pages, 46 references.

Written for biologists, these presentations of principles and methods have a minimum of physical and mathematical formulation. The topics closest to classical cytology (and with the greatest current numbers of publications) are presented in greatest detail, with the treatment of x-ray diffraction reduced to elementary principles. Originally covering developments through 1952, the manuscripts have been revised immediately prior to publication to include outstanding work into 1955.

A particularly lucid account of the theory and practice of phase and interference microscopy is presented by Barer with the aid of simple geometry. Microspectrophotometry is dealt with in two sections with emphasis (for the visual) on practical details by Pollister and Ornstein, and (for the ultraviolet) with an objective critical evaluation of principles by Nurnberger. After a brief statement on methods in electron microscopy, Selby gives a valuable summary of the major morphological findings on tissue cells. Most of the remaining subjects have been presented earlier in monograph or review form; but, in addition to the convenience of their collection in one volume, the work of the editor can be admired for scaling the length of individual presentations and their technical level to meet the interests and capacities of a wide biological audience.

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Studies of Biosynthesis of Escherichia coli. Publication 607. Richard B. Roberts, Dean B. Cowie, Philip H. Abelson, Ellis T. Bolton, and Roy J. Britten. Carnegie Institution of Washington, Washington, D.C., 1955. xiv + 521 pp. Illus. Paper, $2.50; cloth, $3.

This is a rather unique book. It reports the studies of one laboratory on primarily one strain of bacteria, *E. coli* B. There are occasional studies for comparative purposes on yeasts, *Neurospora*, and sometimes *Chlorella*. About 10 percent of the book is devoted to the general methods, particularly to those involving radioactive tracers. This is followed by a section on permeability of the cell wall, first to inorganic ions, then to organic substances.

From the distribution of the isotopes, it is concluded that not only inorganic ions are easily diffusible but every organic compound used, including glucose-1-phosphate and fructose-1,6-diphosphate. This conclusion that the cell wall is unable to exclude small molecules leads to the supposition that the cell wall is a mere morphological boundary and that the protoplasm is in direct contact with the environment. This is curious, since a variety of other studies would have led one to suppose differently. *E. coli* is shown to be capable of incorporating CO_2 into the aspartic-glutamic system, arginine, purines, and pyrimidines; acetate into lipids, leucine, and the Krebs cycle. Similarly paths are traced for glucose, amino acids, formate, formaldehyde, and so forth. This material occupies possibly half of the book, some of it scattered throughout.

The authors then attempt, with a good degree of success, to integrate this information. There are discussions of variations in metabolism caused by adaptation to different energy sources, and there is a study of extracellular products of metabolism. There are detailed discussions of the role of the Krebs cycle, the synthesis of the glutamic-aspartic families of amino acids (in which proline, arginine, lysine, homoserine, threonine, methionine, and isoleucine are included), the syntheses of other amino acids, complete with charming family pictures (the aromatics, the pyruvic family, and the serine family). There is a long and fascinating section on nucleic acid synthesis and perhaps too long a section on sulfur metabolism. This is followed by a chapter on the mechanism of isotopic competition, and then by a masterly summary, particularly from the kinetic viewpoint. There is an extensive, pertinent bibliography attached.

Aside from detailed and intricate metabolic pathways, it appears that in attempting to explain why compounds supplied externally do not behave identically with those formed by the cell, the important conclusion is reached that the endogenous compounds are not indeed identical with the external material (the acetyl coA and acetate system being a model) and that this applies to virtually all the materials studied. Although this is not an exactly new concept, it is here clearly formulated, experimentally supported, and extended to include substances not usually considered in this light. This is a stimulating and valuable book, a careful and detailed experimental consideration of a limited area *E. coli* B, which may indeed prove large enough at that.

WAYNE W. UMBREIT
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Mechanisms of Microbial Pathogenicity. Fifth symposium of the Society for General Microbiology. J. W. Howie and A. J. O'Hea, Eds. Cambridge Univ. Press, New York, 1955. x + 333 pp. $5.

The 16 papers by British and American authors in this fifth symposium of the Society for General Microbiology constitute an impressive compilation of ideas on the disease-producing capacities of selected bacteria, protozoans, and fungi that infect man, animals and plants. The breadth of the area covered is great, but bringing together data and ideas from fields that are related but commonly held at arms length (for example, bacteriology and protozoology)

is stimulating and should provoke new investigations. The first paper by A. A. Miles on "The meaning of pathogenicity," as its title implies, is preoccupied with definitions. The remaining authors do not always conform to his suggestions on the use of the terms *pathogenic* and *virulent*, but little confusion results. The ideas expressed in Theobald Smith's philosophic classic *Parasitism and Disease* are alluded to repeatedly. It is, however, by no means clear that these ideas have had an important impact in the field—at least so far as the contributions to the present volume are concerned.

As might be expected, understanding of the mechanisms of action of specific toxins, whether in plants or animals, is better understood than the invasive manifestations of microorganisms, and excellent progress is being made from this approach. This is exemplified in the chapter by Smith and Keppie on pathogenesis of anthrax and in the chapters by Wood and by Brian on the role of toxins, whether enzymes or small molecular substances, in certain plant diseases. The discussion of the relative importance of lycomarasmin and pectic enzymes in tomato wilt is particularly instructive.

Somewhat questionable statements occur in a few places. For example, on page 34 it is stated that the somatic antigen of *Sh. shigae* is protective against the disease, and on page 187 the immunological response to infection is described in terms so mechanistic that they can hardly be accepted as constituting a valid generalization.

This book is strongly recommended to those interested in the pathogenic properties of microorganisms.

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Philosophy and Analysis. A selection of articles published in *Analysis*, 1933–40 and 1947–53. Margaret Macdonald, Ed. Philosophical Library, New York, 1954. viii + 296 pp. $7.50.

Philosophy and Analysis consists of 37 articles, all except two of which had been previously published in *Analysis* between 1933 and 1940 and between 1947 and 1953. *Analysis* has played a unique role in publishing short articles on precisely defined philosophical questions and in offering an exchange of views among like-minded philosophers. Unfortunately, its limited circulation made reference difficult; hence, the present collection fills an important gap, not only for technical workers in this field, but also for educated laymen, who are here provided with more variety and continuity than is available in any single issue of such a highly specialized journal. This cultivation of small-scale, rather than large-scale, philosophies has been quite fruitful. As a result there has been a tendency for philosophers to concentrate on separate problems in contrast to their previous procedure of issuing pronouncements about the whole universe.

A very helpful introduction is provided by Margaret Macdonald, editor of *Analysis*. She undertakes to clarify the special outlook or attitude represented by this journal, which is concerned primarily with philosophical analysis and the application of the method of logical analysis to philosophic problems. She points out that this concept was introduced by Moore and Russell and later extended by Wittgenstein.

In general, the idea is "that philosophical problems might be solved by a better understanding of the meaning of language." In other words, "To find out what a sentence means or a proposition asserts one must deduce those other propositions upon which its truth depends." This is related to Russell's *Principle of Acquaintance*—namely, "Every proposition which we can understand must be composed wholly of constituents with which we are acquainted." All this is in line with Moore's *Defence of Common Sense*, "That we understand and know for certain the truth of many statements of ordinary life, though we do not know their analysis." Moore's position may be stated, "To be understood, a philosophical statement, or problem, must be explained in ordinary, that is, known philosophically technical language. When so explained, one will find that the problem concerned can be solved, or shown to be soluble, which is a kind of solution, only by careful examination of the uses of certain words in oridnary contexts."

In this connection there has been considerable influence by Wittgenstein and members of the Vienna group through their principle of verifiability—namely, "A proposition is significant if it is logically possible that it should be verified by one reporting an experience. . . . If not so verifiable, a proposition is either analytic tautologist or nonsensical, which includes metaphysical." Usually one "does not so much try to answer philosophical questions or solve philosophical problems as ask in what sense of 'question' and 'problem' they are questions and problems and what sort of answer would satisfy those whom they puzzle." It is significant that analytic philosophy has concentrated on certain problems while completely ignoring others. Thus the present collection is concerned with questions in logic and epistemology—that is, problems such as meaning, knowing, truth, and probability.

There is included an article on "The relationship between philosophy and psychology" and also one on "Ethics." Probably most interesting to the general reader are some papers that appeared in 1939 dealing with dialectic materialism as presented by speakers from both sides.

Although recognizing the value of linguistics per se and of semantics in general, the average scientist may well look askance at this kind of approach, which, however, may be justified as an attempt to present a unified and coherent word description of experiential ideas.

RAYMOND J. SEEGER
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Linearized Theory of Steady High-Speed Flow. Cambridge monogr. on mechanics and applied mathematics. G. N. Ward. Cambridge Univ. Press, New York, 1955. xv + 243 pp. Illus. $6.

This book is a systematic and coherent account of the basis of linearized theory of steady flow. It is written in a careful and scholarly style. The approach to the subject matter is formal in the sense that general methods are studied first and the special cases extracted and in that formal mathematics is used to deduce all the theorems and representation formulas.

The book is divided into three parts: "General theory," "Special methods," "Slender body theory." Chapter 1 presents the assumptions (perfect gas, inviscid fluid), exact equations under those assumptions, and derivation of linearized equations. Chapters 2 and 3 give general solutions for subsonic (Laplace equation) and supersonic (wave equation) flows in terms of the basic elements, sources, vortices, and so forth, and integral formulas, domains of dependence, and so on. Chapter 4, an especially interesting chapter, discusses usually troublesome points of the theory, such as boundary conditions, formulas for over-all forces, including the effect of singularities at edges, nonuniformities of approximation at infinity, and also flow reversal theorems.

Chapter 5 presents a brief account of the application of the methods of Chapter 2 to subsonic wing theory. In Chapter 6 the methods of Chapter 3 are applied to supersonic wing theory. The lifting problem is treated in detail by the method of Evard and Krasilshchikova, using characteristic coordinates and the source representation. In Chapters 5 and 6 no specific examples are worked out.

Chapter 7 presents the theory of linearized supersonic conical fields following Goldstein and Ward and applies it to flat wings. Chapter 8 covers those applications of operational methods to

supersonic flows for which the technique is especially suited, mainly quasi-cylindrical bodies and jets. The final chapter is a detailed exposition of slender body theory for subsonic and supersonic flow. The basic approach is to expand exact solutions, represented by singularities, near the axis and to study orders of magnitude carefully.

The desire for a concise account has meant that the working out of examples and comparison of results with more exact theory or experiment has been put aside. Thus an evaluation of the usefulness and an intuitive feeling for the nature of the results has to be found elsewhere. The level of the book is such that the reader with some training in mathematical physics can follow the details. Vector notation is used extensively. There is a good bibliography, except that no reference is made to Russian literature, and there are practically no figures.

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Science and the Human Imagination. Mary B. Hesse. Philosophical Library, New York, 1955. 171 pp. $3.75.

Mary Hesse, lecturer in mathematics at the University of Leeds, has written a slim book about a subject that is increasingly a matter of professional concern—the relationship of science and religion. Her position seems to be adequately summarized in the following passage (p. 155): "The conflicts between science and religion over their respective descriptions of various aspects of experience are usually genuine conflicts about experience, and not mere verbal misunderstandings or confusions of two apparently similar but actually distinct types of language. . . . All . . . attempts to divide the provinces of science and religion are dangerous illusions, they are false for science, because science has a valid claim to investigate *all* aspects of experience, 'spiritual' as well as 'material' . . . they are false also for Christianity, because they deny the concern of the Christian God for the material world which He has created."

Such seems to be the author's most serious message; but she takes up a great deal of space *not* saying it. More than two-thirds of the book is devoted to a pedestrian survey of the development of scientific methodology which bears no obvious relationship to the avowed purpose of the work. She (rightly) disdains a science made impotent to develop new fields by its strong bias in favor of that which can already be symbolized clearly and logically. To speak out boldly in behalf of the still unclear, the still ambiguous aspects of man's situation is admirable but is hardly enjoyable for the reader unless the writer possesses the scintillating literary endowment of a Whitehead or a Wisdom.

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The Chemistry of Petroleum Hydrocarbons. vols. II and III. Benjamin T. Brooks, Stewart S. Kurtz, Jr., Cecil E. Boord, and Louis Schmerling, Eds. Reinhold, New York, 1955. vol. II, vi + 442 pp. Illus. $13.50. vol. III, vii + 690 pp. Illus. $18.

Together with volume I, which appeared in 1954, these volumes constitute the most complete and authoritative summary of our knowledge of the chemistry of petroleum hydrocarbons that is presently available. Volume II contains 16 chapters (Chapters 22 to 37). Chapters 22 to 29 discuss various aspects of cracking (thermal and catalytic) and reforming operations. Specifically, the topics include: mechanisms for the thermal decomposition of hydrocarbons; conditions and results of thermal cracking for gasoline; composition of synthetic and cracked gasolines; acetylene by the pyrolysis of light hydrocarbons; pyrolytic reactions of aromatic hydrocarbons; theory of catalytic cracking; the effects of variables in catalytic cracking; aromatization, hydroforming, and platforming. The related topics of catalytic dehydrogenation and the mechanism of the reactions of nonbenzenoid hydrocarbons are considered in Chapters 30 and 31. The oxidation of hydrocarbons is described in Chapters 32 to 37 under the headings: general theory of hydrocarbon oxidation; low-temperature oxidation of paraffin hydrocarbons, oxidation of paraffin wax; olefin antoxydation; synthesis gas from methane, oxygen, and steam; the partial oxidation of the simple paraffinic hydrocarbons; special oxidation reactions of unsaturated hydrocarbons.

In volume III, which comprises Chapters 38 to 59, a wide variety of topics are discussed as follows: oxidation of orthoxylene to phthalic anhydride; isomerization of saturated hydrocarbons; chlorination of paraffins and cycloparaffins; fluorination and properties of fluoroderivatives of paraffins and cycloparaffins; nitration of paraffins and cycloparaffins; special chemical reactions of paraffins and cycloparaffins; isomerization of olefins; vinyl polymerization; polyethylene; Diels-Alder condensations and related reactions; polymer gasoline; the chemistry of natural and synthetic rubbers; condensation of saturated halides with olefins; catalytic hydrogenation of hydrocarbons; the oxo-reaction; alkylation of saturated hydrocarbons; special reactions of olefins; aromatic substitution—theory and mechanism; industrial applications of aromatic alkylation; sulfonation of aromatic hydrocarbons; nitration of aromatic hydrocarbons.

It is noticed with regret that, in these volumes which seem to have covered the field so completely in other respects, no chapter has been included on the thermodynamics of hydrocarbons.

The field of hydrocarbon chemistry is now so vast and so diversified that it is virtually impossible for an individual to keep informed concerning its many aspects, by reference to the original literature alone. Thus, a real need has existed for a treatise to summarize in one place this vast information. This need has now been filled in an authoritative and readable manner in the three volumes of the *Chemistry of Petroleum Hydrocarbons.*

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New Books

"Krebiozen," The Great Cancer Mystery. George D. Stoddard. Beacon Press, Boston, 1955. 282 pp. $3.50.

Encyclopedia of Chemical Technology. vol. 14, *Thermodynamics to Waterproofing.* Raymond E. Kirk and Donald F. Othmer, Eds. Interscience Encyclopedia, New York, 1955. 980 pp. Single copy, $30; subscription, $25.

Frontiers of Astronomy. Fred Hoyle. Harper, New York, 1955. 360 pp. $5.

The Diseases of Occupations. Donald Hunter. Little, Brown, Boston, 1955. 1046 pp. $20.

Building, Planning and Design Standards. For architects, engineers, designers, consultants, building committees, draftsmen and students. Harold R. Sleeper. Wiley, New York; Chapman & Hall, London, 1955. $12.

The Quantitative Analysis of Drugs. D. C. Garratt. Philosophical Library, New York, rev. ed., 2, 1955. 670 pp. $17.50.

A Short History of Medicine. Erwin H. Ackerknecht. Ronald Press, New York, 1955. 258 pp. $4.50.

One in Six. An outline of the cancer problem. I. Hieger. Wingate, London, 1955. 80 pp. 12s. 6d.

Classical Electricity and Magnetism. Wolfgang K. Panofsky and Melba Phillips. Addison-Wesley, Cambridge, Mass., 1955. 400 pp. $8.50.

The Unified System Concept of Nature. Stephen Th. Bornemisza. Vantage Press, New York, 1955. 137 pp. $3.

Analytic Geometry. Frederick H. Steen and Donald H. Ballou. Ginn, Boston, ed. 3, 1955. 244 pp. $3.50.

Plastics for Corrosion-Resistant Applications. Raymond B. Seymour and Robert H. Steiner. Reinhold, New York, 1955. 423 pp. $7.50.

Scientific Meetings

International Council of Scientific Unions

The International Council of Scientific Unions (ICSU) is prepared to meet the new responsibilities thrust upon it by recent developments in the international field. This fact was amply demonstrated at the 7th general assembly of the council held at Oslo, Norway, 9–12 Aug.

Already engaged in timely and useful world-wide scientific pursuits, ICSU plans to engage in other equally practical enterprises. It has increased its scientific strength by taking new unions into its family, and other unions will almost inevitably seek admission later. It has integrated its work further into the interests of the countries by admitting the U.S.S.R. and facilitating the entry of other countries as national members. It has planned to strengthen its financial independence by adopting a revised pattern of contributions from national members.

The United States, moreover, has shown an increasing interest in the programs of ICSU and its unions. It is probably destined to play an even greater role in the future. An American, Lloyd V. Berkner, was elected to the presidency [*Science* **122,** 566 (1955)], and for the first time a general assembly of ICSU will convene in the United States in 1958.

Since the previous assembly at Amsterdam in 1952, ICSU has carried forward with foresight and vigor in organizing the forthcoming International Geophysical Year (IGY), described in earlier issues of *Science* [**119,** 3A (9 Apr.), 457, 569 (1954); **121,** 664, 751 (1955); **122,** 234, 322, 461, (1955)]. A report on the progress of this world-wide program highlighted a new and unique organization for carrying out international scientific cooperation. In order effectively to develop comprehensive programs, ICSU, which initiated the undertaking, asked certain of its unions to set up their own planning committees and sought the collaboration of other interested international organizations. It also asked that national committees be established to prepare national plans for the IGY study. The plans of all these groups are being coordinated by the Comité Spécial de l'Année Géophysique Internationale (CSAGI) that ICSU had created at the Amsterdam assembly. This kind of organization reflects the considered thoughts of scientific and national members of ICSU, as well as those of others, and combines the efforts of all in bringing into the programs new features demanded by modern times.

Two such features of the IGY program merited special mention at the Oslo meeting; the Antarctic study and plans for launching an artificial world satellite. In the Antarctic ICSU will make possible the study of one-sixth of the world, a large part of which has not been seen by the human eye. With regard to the plan for the satellite launching [*Science* **122,** 322 (19 Aug. 1955)], the peaceful international setting in which it was announced was emphasized, and the scientific objective of ICSU and the IGY, as opposed to the political objective, was pointed out.

Although ICSU has already begun the IGY activity, new developments in the world require that it enter upon other scientific fronts. Thus, at the assembly the delegates considered plans for the study of the biological effects of nuclear radiation. The International Union of Biological Sciences at its Rome meeting last April had asked that the general assembly at Oslo accept responsibility for undertaking such a study. During the discussion of this matter, the new moves on the part of the United Nations for clarification of issues connected with the biological effects of nuclear radiation were considered. In the light of these new moves, the assembly decided to offer to the United Nations through UNESCO its services in connection with the scientific aspects of such matters. In order to provide this assistance, moreover, the assembly agreed that ICSU should establish a special committee to delineate the problems to be explored and to coordinate the information from the studies undertaken.

In the matter of extending ICSU's cooperation to the United Nations, discussions indicated that ICSU can assume only a small, but nevertheless important, part in the study of radiation effects. This part relates to basic science. It is the part in the larger study that precedes the interpretations that must be made and the decisions that must be reached by other agencies. All the information on which decisions must be made is not yet available. If all the nations of the world provide the facts relating to radiation effects, scientists may proceed in assuming their integral role in the larger study. Since the United Nations will apparently consider a mechanism for this collection, the assembly believed that ICSU should face its responsibility by extending the scientific services it is competent to render.

The accumulation of new kinds of scientific data, often cutting across scientific disciplines, and the specialization on the part of certain scientists to the study of these materials are symbolic of the swift and changing times. This modern development of scientific thought has led to fresh groupings of scientists who have reoriented the statements of practical and theoretical problems, reordered a segment of scientific knowledge, and worked out unique scientific methods and techniques. Such new groups of scientists are represented by the International Union of Physiological Sciences and the International Union of Biochemistry. These unions had requested admission to ICSU as new scientific members. In the light of current trends in the growth of scientific thought and on the basis of the qualifications and activities of these organizations, the assembly considered the admission of these two unions timely and desirable. The assembly decided to defer consideration of admitting the International Union of Scientific Psychology, however, pending an advisory report, to be prepared and submitted to the executive board next summer by representatives from appropriate ICSU Unions.

ICSU is expanding its activities, not only by admitting new scientific unions, but also by bringing in new national members. The assembly welcomed the U.S.S.R. into ICSU, and now that country has national, as well as scientific, representation. The Soviet Union already adheres to four of the ICSU scientific unions.

In order to facilitate complete representation in ICSU, the assembly agreed that when a country adheres to one or more of the ICSU unions, the bureau shall invite that country to become a national member. The assembly also agreed that countries that had been delinquent for the past few years in the payment of their dues should be advised of the new pattern of membership contributions, described in following paragraphs, and invited to join ICSU under the revised arrangement.

The assembly decided to strengthen

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They took thirty wether lambs of fine wool breeding at Ames, Iowa, and fed them various non-protein nitrogen compounds. They were exploring the biochemistry behind the current drive for replacing protein with urea, which is cheaper, in ruminant diets. It has been shown that all ten essential amino acids are synthesized in the rumen when urea supplies all the nitrogen. But no sheepman (or cattleman) dares supply all his nitrogen that way. What makes it dangerous? asked the men of Iowa State.

Simply that ammonia is released into the blood, they found. No harm is done—unless the urea feeding is overdone to a certain critical and fatal point. Likewise ammonium formate, ammonium acetate, and ammonium propionate can release lethal concentrations of NH_3 in the rumen. Not so the amides, for the rumen has little amidase; on propionamide, formamide, or biuret sheep may safely graze, as far as ammonia is concerned. The Iowans therefore looked further at these.

Formamide turned out to have some toxicity problems of its own, but propionamide was fine, gave the same weight gain as urea, and in one trial was equivalent to conventional protein at the replacement level of 30 percent. Propionamide appears to release ammonia at a rate just sufficient for adequate protein synthesis by rumen microorganisms, once they and the lambs get used to it.

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For example, a bibliography on soft x-ray microscopy, microradiography, electron radiography, and geometric x-ray microscopy.* It lists every paper and article on those subjects known to us, except that unlike our bibliographies of vitamin E, this is not annotated. The arrangement is alphabetical by authors, whether they be of the industrial, medical, metallurgical, botanical, zoological, entomological, or fine arts persuasions or just plain physicists.

The earliest reference was published April 13, 1896, in *Comptes rendus hebdomadaires des séances de l'Académie des sciences* by F. Ranwez under the title, "Application de la photographie par les rayons Röntgen aux recherches analytiques des matières végétales." The most recent is dated August, 1955, and deals with electron radiography in the investigation of postage stamps. Among the 350-odd items that lie between these two, you will find "Ueber Weichstrahlaufnahmen mit der Gleichspannungsmaschine 'Trifas' der Elektrizitätsgesellschaft 'Sanitas' " (H. Chantraine, *Fortschritte auf dem Gebiete der Röntgenstrahlen vereinigt mit Röntgenpraxis, 38:* 534-541, September, 1928) and "**Микрорентгенография**" (С. В. **Гречишкин,** *Вестник рентгенологии и радиологии, 20:* 397-408, 1938).

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*For the casual reader:

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ICSU's financial structure. A disparity between the increasing need for operating funds and the amounts annually available made this step necessary. ICSU's income is dependent on dues paid by national members and by scientific members, but this income has proved insufficient in the face of rising administrative and operating costs. UNESCO has provided in recent years an annual subvention, a considerable portion of which has had to be used for administration. The assembly acknowledged that the receipt of the grants-in-aid for the work of the unions and other agencies of ICSU has been of the utmost benefit. The assembly believed, however, that in order that ICSU maintain its equality of status, a sufficient income in its proper right, particularly for its own administration, appeared to be a necessity.

As is indicated in foregoing paragraphs, new unions have been admitted into ICSU, and other well-qualified unions will doubtless apply for membership in the near future. New ventures, moreover, have recently been undertaken by ICSU, two of them conspicuously important—the ICSU Abstracting Board and the IGY. The abstracting board makes commonly available in usable form, through arrangements with abstracting journals, the latest scientific knowledge in physics and chemistry. These new undertakings will doubtless be expanded, and other new ventures are likely to follow.

All these matters were thoroughly discussed at the assembly, which reached a decision to augment ICSU's income by adopting a new plan for the payment of national membership dues. In contrast with the present plan, under which national members uniformly contribute $196 and which yields a total annual income of roughly $8000, the new plan is expected to yield about $50,000. At the same time, the plan is so devised that any country need not contribute more than a minimum of $100 but may pay a larger amount if it chooses. Under the revised plan, membership is divided into six categories. A base contribution of $20 will be made by a national member choosing to subscribe to category I membership; $40 if category II; $80 if category III; $150 if category IV; $300 if category V; and $600 if category VI. The annual dues for a national member will be determined by multiplying the base contribution by the number of ICSU unions to which the national member adheres. Thus, assuming that the United States chooses to be a category VI member and adheres to 13 scientific unions, its annual dues will amount to $7800 ($600 × 13). The new plan is expected to come into effect in November 1956. This date gives national members ample time to decide on their categories.

The United States' interest in ICSU's activities and those of its unions has been steadily increasing. American scientists from the Government, the universities, and other institutions have more and more taken leading roles in the programs of these organizations. The National Academy of Sciences–National Research Council has assumed a more active part as the adhering body to these international organizations. Certain Government agencies, particularly the Department of State and the National Science Foundation, have increasingly been concerned with these programs of international science. It was not unnatural, therefore, that the composition of the American delegation [*Science* **122**, 410 (1955)] to Oslo should reflect the interests of all these groups.

As an indication of its increased interest in the programs of ICSU and its unions, the U.S. delegation extended to ICSU, on behalf of the United States Government and the Academy–Research Council, an invitation to hold its 8th general assembly in this country. The assembly unanimously accepted. It will accordingly meet in Washington, D.C., in 1958.

WALTER M. RUDOLPH
U.S. Department of State, Washington, D.C.

Meeting Notes

■ The Society of Rheology will hold its annual meeting in New York at the Henry Hudson Hotel, 2–4 Nov. At each of five technical sessions, four papers will be presented, thus allowing ample time for discussion and questions.

This year's meeting will feature an unusually wide field of subject matter: plasticity studies of metals; flow phenomena encountered in geologic studies; and rheology of polymeric materials. Two sessions will be devoted to papers on a number of different subjects, including hypoelasticity, fracture of viscoelastic liquids, and determination of dispersion structure by viscometry. As in the past, nonmembers are welcome. Complete programs are available from F. D. Dexter, Bakelite Co., Bound Brook, N.J.

■ Surgery of the heart will be featured in the program of the 41st annual clinical congress of the American College of Surgeons that is to take place in Chicago, Ill., 31 Oct.–4 Nov. The program includes 30 separate lectures, scientific exhibits, discussion sessions, and television and motion-picture demonstrations describing heart operations considered impossible until very recently.

Attendance at the congress is expected to reach 10,000, including surgeons and other physicians from all over North America and many foreign countries. In addition to heart surgery, the program will present results of research and demonstrations of new techniques in all branches of surgery. Especially important is the "Forum on fundamental surgical problems," in which younger surgeons conducting original research programs will present the results of their experimental work to an audience of practicing surgeons.

More than 175 projects will be considered this year, grouped into forum sessions on surgery of the heart and great vessels, infections and burns, surgery of the gastrointestinal tract, urology, plastic surgery, metabolism and nutrition, surgery of the liver and pancreas, orthopedics, tumors, gynecology and obstetrics, surgery of the lungs, and neurosurgery.

During the congress, operations performed at the University of Illinois Research and Educational Hospitals will be telecast in color to screens in the hotel meeting rooms. Surgeons in the audience may relay questions to the operating team while the operation is in progress, and the questions may be answered and discussed during the presentation.

Major addresses will be presented by Warren H. Cole of the University of Illinois, who is succeeding Alfred Blalock of Johns Hopkins University as president of the college, and by Grayson Kirk, president of Columbia University. Frank B. Berry, Assistant Secretary of Defense, will deliver the annual Trauma Oration; his subject is "Mass casualties."

■ At its meeting in Zurich on 23 July, the Commission on Macromolecules of the International Union of Pure and Applied Chemistry made the following decisions regarding the International Symposium on Macromolecular Chemistry, to be held in Israel, 3–9 Apr. 1956:

1) From 10 to 20 minutes will be allowed for each paper.

2) The official languages of the symposium will be French and English.

3) *Before 1 Dec. 1955,* a full abstract (up to 1000 words) should be sent to the central office of the symposium at the Weizmann Institute of Science, Rehovoth, Israel.

4) *Before 1 Feb. 1956,* two copies of the manuscript should be sent to the central office of the symposium.

5) Abstracts of the papers to be presented will be printed by the Weizmann Scientific Press in book form and provided, free of charge, at the beginning of the symposium.

6) Papers and discussions will be published in a special issue of the *Journal*

of Polymer Science before the end of 1956.

7) Preprints of the manuscripts will not be available at the symposium, but galley proofs will be sent to authors by the *Journal of Polymer Science.*

Forthcoming Events

November

3–4. Hawaiian Acad. of Science, Honolulu, T.H. (D. C. Cox, 1527 Keeaumoku St., Honolulu 14.)

7–9. Assoc. of Military Surgeons of the United States 62nd annual, Washington, D.C. (AMSUS, 1726 Eye St., NW, Washington 6.)

7–9. Geological Soc. of America, annual, New Orleans, La. (H. R. Aldrich, 419 W. 117 St., New York 27.)

7–9. Mineralogical Soc. of America, New Orleans, La. (C. S. Hurlbut, Jr., 12 Geological Museum, Oxford St., Cambridge 38, Mass.)

7–9. Paleontological Soc., New Orleans, La. (K. E. Caster, Dept. of Geology, Univ. of Cincinnati, Cincinnati 21, Ohio.)

7–9. Soc. of Economic Geologists, New Orleans, La. (O. N. Rove, Union Carbide and Carbon Corp., 30 E. 42 St., New York 17.)

8. Assoc. of Geology Teachers, New Orleans, La. (R. L. Bates, Dept. of Geology, Ohio State Univ., Columbus 10.)

9–12. American Council of Independent Laboratories, Phoenix, Ariz. (H. M. Dudley, 4302 East-West Highway, Washington 14.)

9–13. International Symposium on Tuberculosis in Infancy and Childhood, Denver, Colo. (L. S. Smith, National Jewish Hospital, Denver 6.)

10. Assoc. of Vitamin Chemists, Chicago, Ill. (M. Freed, 4800 S. Richmond, Chicago 32.)

10–11. American Philosophical Soc., Philadelphia, Pa. (L. P. Eisenhart, 104 S. 5 St., Philadelphia 6.)

10–12. American Astronomical Soc., Troy, N.Y. (J. A. Hynek, McMillin Observatory, Ohio State Univ., Columbus 10.)

10–12. American College of Cardiology, 4th, Memphis, Tenn. (P. Reichert, American College of Cardiology, Empire State Bldg., New York 1.)

11. Centennial Symposium on Modern Engineering, Philadelphia, Pa. (C. C. Chambers, Univ. of Pennsylvania, Philadelphia.)

11–12. Inter-Society Cytology Council, 3rd annual, Cleveland, Ohio. (P. F. Fletcher, 634 N. Grand Ave., St. Louis 3, Mo.)

11–13. United Cerebral Palsy Convention, 6th annual, Boston, Mass. (Convention Dept., UCP, 369 Lexington Ave., New York 17.)

13–18. American Soc. of Mechanical Engineers, 75th annual, Chicago, Ill. (C. E. Davies, 29 W. 39 St., New York 18.)

14–16. Technical Conf. on Electrical Techniques in Medicine and Biology, 8th annual, Washington, D.C. (T. Rogers, Machlett Laboratories, 1063 Hope St., Springdale, Conn.)

14–17. International Automation Exposition, 2nd, Chicago, Ill. (R. Rimbach Assoc., 845 Ridge Ave., Pittsburgh 12, Pa.

14–17. American Petroleum Inst., 35th annual, San Francisco, Calif. (API, 50 W. 50 St., New York 20.)

14–18. American Public Health Assoc., Kansas City, Mo. (R. M. Atwater, APHA, 1790 Broadway, New York 19.)

14–18. New England Inst. for Hospital Administrators, 7th, Boston, Mass. (D. Conley, ACHA, 620 N. Michigan Ave., Chicago 11, Ill.)

15–17. American Meteorological Soc., Honolulu, Hawaii. (K. C. Spengler, AMS, 3 Joy St., Boston 8, Mass.)

15–17. Geophysical Soc. of Hawaii, Honolulu. (L. Eber, Pineapple Research Inst., Honolulu.)

16–17. Industrial Hygiene Foundation, 20th annual, Pittsburgh, Pa. (C. R. Walmer, IHF, Mellon Inst., Pittsburgh.)

16–18. Soc. for Experimental Stress Analysis, Chicago, Ill. (W. M. Murray, SESA, Box 168, Cambridge 39, Mass.)

17–19. American Anthropological Assoc., Boston, Mass. (W. S. Godfrey, Jr., Logan Museum, Beloit College, Beloit, Wis.)

18–19. American Mathematical Soc., Knoxville, Tenn. (E. G. Begle, Yale Univ., New Haven 11, Conn.)

(See 16 Sept. issue for comprehensive list)

Equipment News

■ AUTOMATIC TITRATOR that employs the second derivative of the voltage/volume function both to determine the end-point of a titration and to actuate a burette valve at that point represents the successful instrumentation of H. V. Malmstadt's method for potentiometric titration [*Anal. Chem.* **26**, 1348 (1954)]. It is reported that the new automatic procedure can be applied to all common types of oxidation, reduction, acid-base, precipitation, and compleximetric titrations. The new instrument consists fundamentally of a mixing and delivery unit with associated supports and an electronic control circuit based on that originally described by Malmstadt. Neither preselection of voltage nor predetermination of cutoff point is required. The potential difference between the electrodes in the titration cell is amplified, differentiated, and filtered to produce a signal of sufficient amplitude to actuate the burette valve. The instrument maintains delivery at full rate until the cutoff point is reached. It is equipped with a recorder outlet by means of which second derivatives may be recorded. (E. H. Sargent and Co., Dept. Sci., 4647 W. Foster Ave., Chicago 30, Ill.)

■ LABORATORY HOTPLATES (three models) that employ open-wire heating elements are intended to provide rapid and precise control of boil-up rates in aniline point determinations and benzol and turpentine distillations. A double radiation shield, one part made of stainless steel and the other of an aluminum-asbestos combination, insures that maximum heat reaches the flask and also prevents the blistering of bench tops. A "flip-over" ceramic top is beveled to accommodate large or small flasks. The heaters can be used in any Flexaframe set-up by the use of integral clamps which are provided. All three models are cased in stainless steel. (Fisher Scientific Co., Dept. Sci., 717 Forbes St., Pittsburgh 19, Pa.)

APPLICATION FOR HOTEL RESERVATIONS

122nd AAAS MEETING

Atlanta, Ga., December 26-31, 1955

The list of hotels and their rates and the reservation coupon below are for your convenience in making your hotel room reservation in Atlanta. Please send your application, *not* to any hotel directly, but to the AAAS Housing Bureau in Atlanta and thereby avoid delay and confusion. The experienced Housing Bureau will make assignments promptly; a confirmation will be sent you in two weeks or less. **As in any city, single-bedded rooms may become scarce; double rooms for single occupancy cost more; if possible, share a twin-bedded room with a colleague—and also save money.** Mail your application *now* to secure your first choice of desired accommodations. All requests for reservations must give a definite date and estimated hour of arrival, and also probable date of departure.

HOTELS AND RATES PER DAY

★ **Hotels starred have sessions in their public rooms.** Most hotels will place comfortable rollaway beds in rooms or suites at 2.50 or 3.00 per night. For a list of headquarters of each participating society and section—and for information on **dormitory accommodations** at Atlanta University and Georgia Institute of Technology—please see *Science,* July 22, or *The Scientific Monthly,* August.

Hotel★	Single	Double Bed	Twin Bed	Suite
Georgia Tech Zone				
Atlanta Biltmore★	6.00–10.00	8.00–14.00	10.00–14.00	15.00–50.00
Cox-Carlton	4.00– 6.00	6.00– 8.00	6.00– 8.00	14.00–16.00
Georgian Terrace	5.00– 8.00	8.50–11.00	8.50–12.00	12.00–22.00
Peachtree Manor	5.00– 8.00	7.50– 9.50	8.50–12.00	15.00–28.00
Downtown Zone				
Atlantan	4.00– 5.50	6.00– 8.50	8.50–10.50	17.00
Dinkler Plaza★	6.00– 8.50	7.00–11.50	13.00–15.00	12.00–35.00
Georgia★	4.00– 7.00	6.00– 9.00	7.00–10.00	15.00–20.00
Hampton	2.50– 4.00	3.50– 5.00	5.00– 7.00	
Henry Grady★	5.50–12.00	9.00–12.00	9.50–12.00	16.00–25.00
Imperial	4.00– 5.50	6.00– 6.50	6.50– 7.00	
Jefferson	3.00– 3.50	4.00– 5.00	4.50– 5.00	
Peachtree on Peachtree	5.00– 7.00	7.50–10.50	8.50–10.50	10.00–18.00
Piedmont★	5.50– 8.00	7.50–10.00	10.00–14.00	20.00–25.00
As required by local laws, the following are available for Negro members and visitors:				
Royal Hotel 214 Auburn Ave., N.E.	4.00	5.00		
Savoy Hotel 239 Auburn Ave., N.E.	2.50	3.50– 4.50		
University Motel 55 Northside Drive, N.W.	5.00	8.00		

THIS IS YOUR HOTEL RESERVATION COUPON

AAAS Housing Bureau
Room 912, Rhodes-Haverty Bldg.
Atlanta 3, Ga.

Date of Application .....

Please reserve the following accommodations for the 122nd Meeting of the AAAS in Atlanta, Dec. 26–31, 1955:

TYPE OF ACCOMMODATION DESIRED

Single Room ..... Desired Rate ..... Maximum Rate .....

Double-Bedded Room ..... Desired Rate ..... Maximum Rate ..... Number in party .....

Twin-Bedded Room ..... Desired Rate ..... Maximum Rate .....

Suite ..... Desired Rate ..... Maximum Rate ..... Sharing this room will be:

(Attach list if this space is insufficient. The name and address of each person, including yourself, must be listed.)

.....

.....

First Choice Hotel ..... **Second Choice Hotel** ..... **Third Choice Hotel** .....

DATE OF ARRIVAL ..... DEPARTURE DATE .....
(These must be indicated—add approximate hour, a.m. or p.m.)

NAME .....
(Individual requesting reservation) (Please print or type)

ADDRESS .....
(Street) (City and Zone) (State)

Mail this now to the Housing Bureau. **Rooms will be assigned and confirmed in order of receipt of reservation.**

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50,055-W	Cesium	29.20	50,061-W	Neon	29.20
50,056-W	Helium	29.20	50,062-W	Rubidium	29.20
50,057-W	Mercury	29.20	50,063-W	Thallium	29.20
50,058-W	Mercury Cadmium	32.30	50,064-W	Zinc	29.20
50,059-W	Potassium	29.20	50,065-W	Mercury Sulphide	38.48

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For use with infra-red telescopes, camera attachments, etc. Light from a 100-watt bulb passing through the filter is transformed to infra-red light source. Used on jeep headlights with infra-red driving instruments. ⅛" thickness.

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INFRA-RED IMAGE TUBE

Used inside an infra-red telescope, this miniature tube converts infra-red rays to visible rays on the tube screen, which is viewed by an ocular. British import. Cylindrical shape, approximately 2" diameter, 1⅝" long. Requires standard vibra-pack electrical source.

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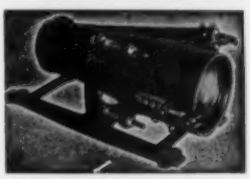

This instrument, an item of war surplus, was originally designed to check navigational instruments. It is being used by industry as a collimator for optical instruments, for testing lenses for definition, as a source of infinite light, and for photographing reticles at infinity. It is also being purchased by many firms as a source for the fine lenses and parts it contains. Consists of a large cemented achromat, 5" in diameter, with a focal length of approximately 25", a pin point reticle lighted by a 6–8 volt bulb (to represent a star), a first-surface mirror to reflect the light from the reticle. Overall length 14⅝"; width of cradle 7⅝". Slightly used, but guaranteed in good working order. Shpg. wt. 15 lbs.

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Stock No. 30,143-W ..... **$8.25 Pstpd.**

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Useful Telescope and Microscope combined in one amazing, precision instrument. Imported! No larger than a fountain pen. Telescope is 10 Power. Microscope magnifies 50 Times. Sharp focus at any range. Handy for sports, looking at small objects, just plain snooping.

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POSITIONS WANTED

Internist, Diplomate; scientific background, M.S.; 4 years of teaching and research; 3 years as director research, pharmaceutical company. Medical Bureau (Burneice Larson, Director), Palmolive Building, Chicago. X

Virologist; Ph.D.; research experience with animal and human viruses; tissue culture; chemistry and mathematics background; publications; desires position in research, industry, or teaching. Box 257, SCIENCE. X

Medical and Biological Translations; abstractions carefully and scientifically done by university graduate from French, German, Italian and Russian. Box 252, SCIENCE. 9/30, 10/7, 14

Virologist; M.S., desires position as research assistant; experienced in fundamental procedures; also tissue culture experience. Box 253, SCIENCE. X

POSITIONS OPEN

(a) Biochemist, Ph.D.; research on liver diseases; will consider man with master's provided he has had 9 years' experience; minimum $7200. **(b) Virologist;** research department, pharmaceutical company; East. **(c) Biochemist;** experienced with chemistry of body and appreciation of properties and modes of action of drugs; preferably one experienced in physiology and pharmacology; product development laboratories, large pharmaceutical company. **(c) Cytologist** or **Cyto-technician** and **Chemistry Technician,** preferably organic chemistry; large teaching hospital; East. **(e) Physician** to join staff, pharmaceutical company; duties: clinical research, industrial medicine; East. S10-1 Medical Bureau (Burneice Larson, Director), Palmolive Building, Chicago. X

Chief, investigative medicine; certified internist preferred; splendidly equipped clinical and research laboratory, metabolic ward, radioisotope unit; duties executive coordination of research entire staff and residents. Also vacancy **director, radioisotope unit;** general hospital, 1000 patients; affiliated Baylor Medical College; faculty appointment; citizenship required. Manager, VA Hospital, Houston, Texas. 10/7

Creative organic chemist, well-rounded in fundamental and practical synthetic know-how, to serve as responsible investigator in development of new pharmaceuticals; offers fine opportunity for growth and satisfaction. Box 246, SCIENCE. 9/23, 30, 10/7

Histologist; M.S. or equivalent independent research experience for histological–histochemical research in a large Chicago cosmetics company; experience with tissue metabolism techniques desirable; position offers excellent potential for advancement in biochemical research; minimum starting salary $4500; company insurance and retirement plans and many other excellent employee benefits. Write, giving full details in first letter. Personnel Department, The Toni Company, Rm. 440, Merchandise Mart, Chicago 54, Ill. X

Research Assistant for research position in industrial pharmacy (eastern seaboard); minimum requirement M.S. in pharmacy or in related field with industrial experience. Salary open. Box 256, SCIENCE. 10/14, 21, 28

POSITIONS OPEN

Neuropsychiatrist for chief, neuropsychiatric service, new Veterans Administration Hospital; opportunity to open service of 80 beds; well-equipped, including EEG laboratory; board certification essential; teaching experience desirable; faculty connection available, strong medical school, to right man; active residency program now in operation in 8 specialties. Write Manager, VA Hospital, Dallas 2, Texas. 10/7

Research Associate for research position in industrial pharmacy (eastern seaboard); minimum requirement Ph.D. in pharmacy or in related field with industrial experience. Salary open. Box 255, SCIENCE. 10/14, 21, 28

Wanted: well-trained, board certified or board eligible young internists for assignment to full-time staff, medical service, expanding 500-bed GM&S hospital; major teaching unit affiliated with state university medical school; teaching experience and interest in clinical investigation desirable. Write Manager, VA Hospital, Dallas 2, Texas. 10/7

GRANTS

1956 Research Grants

The Arctic Institute of North America is offering research grants in 1956 for scientific investigations dealing with the arctic and subarctic regions of North America. Applications for research grants are invited from those who have demonstrated their ability to conduct research work of superior quality in some field of science. Proposals in the broad field of the earth sciences, in marine biology, and in physiology are especially invited. Facilities of the Arctic Research Laboratory at Barrow, Alaska, including housing and equipment, are available to scientists for both summer and winter investigations. Completed applications should be received before 1 November, 1955. For information and forms write Arctic Institute of North America, 1530 P. Street, N.W., Washington 5, D.C., or 3485 University Street, Montreal 2, Quebec, Canada.

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SUPPLIES AND EQUIPMENT

Herman A. Liebhafsky, Ph.D. (Chem.) Univ. of Calif. (1929), joined the General Electric Research Laboratory in 1934. Since 1951 he has been *Manager, Physical Chemistry Research.* In addition to his work in instrumental analysis, Dr. Liebhafsky has been connected with the mercury boiler, the chemistry of oxide-coated cathodes, corrosion problems of all kinds, analytical methods for silicones, and rocket propellants. He has published more than ninety papers in these fields.

X-rays speed materials analysis

Dr. Herman A. Liebhafsky of the General Electric Research Laboratory finds new uses for invisible rays

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Over a period of more than ten years, Dr. Herman A. Liebhafsky and his associates at the General Electric Research Laboratory have contributed to the development of x-ray *absorption* methods for a wide range of materials. Their fundamental work has led to the development of the x-ray photometers, which have proved exceedingly useful in the atomic energy program and in the petroleum industry.

More recently, Dr. Liebhafsky has turned his attention to research on x-ray *emission* spectrography. This new analytical technique has proved especially valuable for the rapid quantitative determination of heavy metals in certain alloys, for the measurement of very thin films of one metal on another, and for the identification and determination of trace materials.

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